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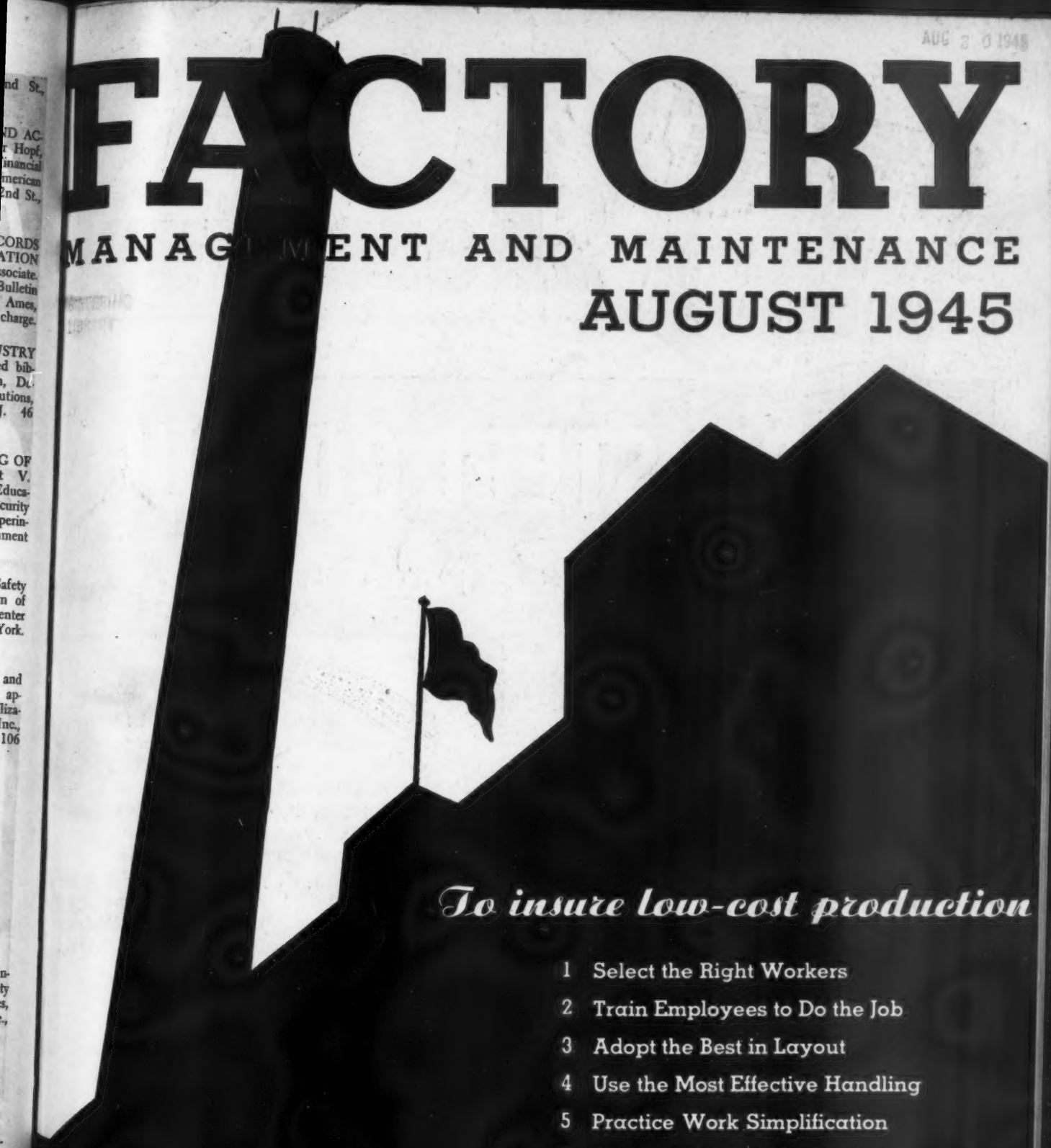
FACTORY

MANAGEMENT AND MAINTENANCE

AUGUST 1945



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2. Train Employees to Do the Job
3. Adopt the Best in Layout
4. Use the Most Effective Handling
5. Practice Work Simplification
6. Plan and Control Production
7. Make the Plant a Good Place to Work
8. Evaluate Jobs and Pay Accordingly
9. Keep Equipment and Plant in Condition
10. Provide Management Controls

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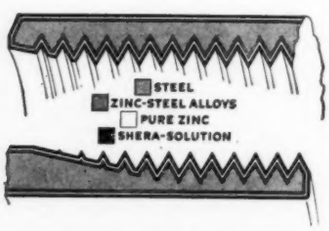

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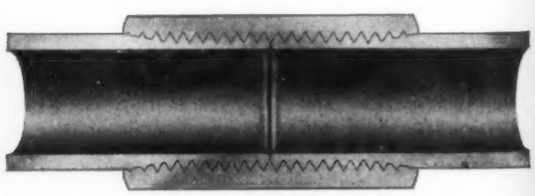

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FACTORY

MANAGEMENT AND MAINTENANCE

AUGUST, 1945

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WHAT PEACE WILL MEAN TO INDUSTRY

THE BASIS of a generally confident industrial outlook came clearly into view as the Japanese surrender gave the "green light" to all-out reconversion. These factors were noted:

First, a clean break gives everyone a fair, flying start—with less eventual cost to the taxpayer and a quicker return to peacetime fiscal policies. Second, a market hungry for goods provides industry with an *incentive* that may bring about almost as many miracles of speed and production as did the war itself.

Finally there is industry's own optimism. This is expressed by a recent Commerce Department Survey (see "Industrial Expansion"), by the National Association of Manufacturers (see "Unemployment"), and by the important employment survey of the Committee for Economic Development (see "Post-War Manufactures and Jobs").

Shocks and dislocations there will be. But Director John W. Snyder of the Office of War Mobilization and Reconversion may yet be surprised to find that his comprehensive report of August 16 was a bit on the gloomy side. And so, too, may certain other public figures who have set high estimates on probable unemployment.

Following are the principal developments of the first week after the Japanese surrender:

1. Cutbacks. Army and Navy cut many billions from procurement programs. Snyder announced policy not to produce useless armaments even a day to "cushion" reconversion shock.

2. Unemployment. Labor leaders predict up to 10,000,000 unemployed, but industrial leaders show confidence the number will be relatively low.

3. Manpower Shift. All controls lifted. Workers' desires to "stay put" remained an unsolved problem.

4. Demobilization. Return of 7,000,000 veterans to civilian status expected in one year. Inductions continue.

5. Civilian Goods. Manufacturing starts programs to reach highest peacetime production in history and expects to reach this goal in a surprisingly short time.

6. Materials. Huge quantities of most raw materials become immediately available for civilian production.

7. Federal Controls. Practically all WPB controls are dropped. Remainder to follow as rapidly as possible.

8. Industrial Expansion. Expenditure of $9,200,000,000 for plant facilities, inventories, and credits scheduled.

9. Surplus Property. Simplified procedure helps expedite program for disposal of billions in surplus property.

10. Small Business. Loans, priorities, and other aids pledged to aid small business in reconversion period.

11. Terminations. Rapid progress expected in disposal of remaining contract termination settlements.

12. Planning. Full Employment Bill will hold center of stage with reconvening of Congress.

13. Prices and Wages. Government will simultaneously combat forces of both inflation and deflation.

Cutbacks

LONG-RANGE PLANS for gradual, selective cutbacks in war production were knocked into a cocked hat by the Japanese surrender.

The War Department moved promptly to strip munitions expenditures to the bone—94 to 100 percent on aircraft, ordnance, and the like. This reduced total Army procurement from a scheduled $2,400,000,000 per month to $435,000,000, of which $268,000,000 will go for food. The Navy acted to knock out $9,000,000,000 in contracts, stopped work on 95 ships, but promised that its total program would not be quite so drastically reduced as that of the Army. The Maritime Commission planned to finish ships already near completion and others having definite post-war value while canceling all the rest.

Where possible, every attempt will be made to pursue the original policy of spotting cutbacks where the shock will be felt least. But this, except as it applied to certain

Navy situations, was a distinctly minor objective. And, said Reconversion Director John W. Snyder, the government will not continue "the manufacture of useless armaments for as much as one day to cushion the shock."

Unemployment

DOLLAR VOLUME OF CUTBACKS was no longer a speculation of interest. But the amount of unemployment to result from it started a national guessing game.

Estimates ran as high as 10,000,000 within the next few months. This came from Sidney Hillman of the CIO. The National Association of Manufacturers, on the other hand, predicted that fewer than 1,500,000 manufacturing workers would be unemployed for more than a month because of reconversion layoffs. A recent NAM survey showed that 61 percent of manufacturing companies have no reconversion problem at all while only 11 percent will need more than 30 days to get back into peacetime production.

The real answer appeared to depend on the following factors:

1. Would displaced war workers go quickly into the service industries and other trades?
2. Would women, older workers, and others from reserve labor sources drop quickly out of the labor market?
3. Would large numbers of demobilized servicemen return before industry was ready with jobs?

Said Reconversion Director Snyder:

"Perhaps as much as half the 8,000,000 workers now employed in war plants will be able to stay with their employers to produce civilian goods of the same kind they are now making for the armed forces. The number who will be laid off, during the next two months, is estimated to be about 4,000,000 . . . It is expected that there will be 5,000,000 or more unemployed in three months. By spring unemployment may reach about 8,000,000."

But, private economists observed, a good half of the listed "unemployed" will not be so in fact. They will consist of workers collecting insurance on their way out of the labor market and workers on their way from one job to another. Some of the best-qualified analysts predicted that neither production nor employment would fall below 1940 levels in the coming year.

Manpower Shift

SWIFT LIFTING of all manpower controls was the logical first step in meeting one of the gravest of reconversion problems and one for which government was the least prepared.

War Manpower Commission officials hastened to throw the machinery of the United States Employment Service into reverse as a "redeployment" agency. Jobless workers were told to register immediately with USES and employers having job opportunities were asked to draw new applicants from the same source.

There was no machinery—and no immediate prospect of any—for transporting workers at government expense from cutback areas to cities where jobs exist or for assuring the unemployed a minimum $25 a week. Congressional action on these questions was at least two months away. And Presidential power to act in these fields was seemingly lacking. (The late President Roosevelt once sought to undertake similar measures in connection with manpower mobilization but was advised by the Attorney General that he lacked the authority).

Lack of uniformity in state unemployment compensation laws provided a serious complication. Migrant workers are required, in some cases, to return to the states from which they came in order to collect. In other cases, notably Michigan, they must remain on the scene. This meant that workers would be even harder to dislodge from some of the areas where they will be least needed.

It remained to be seen whether or not the average worker had the resources—or the will—to transfer himself either back to his home base or to some new locality where jobs beckoned. There is ground for suspecting that workers once moved are hard to move again. Studies of developments after World War I show that most migrants tend to "stay put" in their new communities—even when jobs vanish.

Demobilization

THE ARMED SERVICES' PLANS for demobilization were rendered somewhat uncertain by continuing doubt as to the size of occupation forces needed in the conquered countries. The War and Navy Departments laid their best guesses on the line for Snyder, however, and this is what he concluded:

"Demobilization will return at least 7,000,000 men to civilian life within the next year."

Army discharges, now running at the rate of 170,000 a month, will probably reach 500,000 a month by the end of the year. The Navy announced a point plan to release 327,000 immediately and reported that it would discharge between 1,500,000 and 2,500,000 within the next year to 18 months. The Army will continue inductions at the rate of at least 50,000 a month, cutting the maximum age to below 26. All plans were subject to change without notice, however. The War Department was still frankly suspicious of further Jap treachery.

Huge transportation and administrative problems will also attend—and may delay—demobilization. Despite a million mix-ups, Army policy—and the Navy's, too—will by and large continue to put the emphasis for priority of discharge on length of service and combat experience. This means 4,000,000 men with good claims to discharge must still be brought home from the European and Asiatic theaters and that many of those already in this country may have to wait their turn—or even be shipped out as replacements.

If discharges reach a total of 700,000 a month in early 1946, which is not impossible, the average employer may expect to get back nearly twice as many men as he lost through induction in any one month during the war.

Preference in hiring will be given veterans in government jobs, by government hiring agencies, and by private employers. A quick and definite solution must now be found to "super-seniority" and similar problems. Lt. Gen. Omar Bradley, who has just taken office as Veterans' Administrator, will have to move fast to meet an unexpectedly colossal job with a creaky and ill-prepared organization.

Civilian Goods

FINAL DAYS OF THE WAR found manufacturing industry in various stages of efforts to boost its output of civilian goods toward the highest volume in history. Barring unexpected obstructions, it appeared that manufacturing will achieve its goals in a surprisingly short time.

Large quantities of some kinds of civilian goods will go into production with scarcely a 24-hour lull following cancellation of Army and Navy orders—textiles, for example. In this case, the immediate reduction of Army buying will be as much as 75 percent.

Similarly, the radio industry looks upon reconversion to the production of sets for civilians as a matter of days, rather than months. At first, production probably will be concentrated largely on small and severely plain models, but by January 1 there should be full-scale output not only on the "economy" types but also on the de luxe styles.

Production of washing machines and refrigerators also will reach large totals much sooner than previously expected. Output of both of these items will be aided by continued priorities assistance from WPB, which can now be broadened by the greater availability of materials.

About the only types of civilian goods used in huge volume by the Army and Navy, which cannot be released to the public in proportionately large volume with the end of the war, are food and leather goods. But there will be some relief for civilians even in these categories.

Housing, however, will continue as a major shortage for a number of years. Experts estimate the nation will be short about 10,000,000 housing units by the time most of the military veterans are demobilized, but only about 400,000 houses are expected to be built in the next 12 months. Although that would be about 80 percent of normal building operations, it will not make much of a dent in the total need. After the first year of peace, the construction industry hopes to build at a rate of 1,000,000 units a year. With continued expansion of population, however, even this double-normal rate would have to continue for about 15 years before the construction industry and its allied suppliers of home equipment and building materials will be able to let down to less than a "boom" basis.

Counted on to be bellwethers of reconversion are the automobile industry, household appliances, machine tools, and at a later date, housing. It was predicted in governmental circles that at least 500,000 automobiles will be produced in 1945—double the output previously planned—and that by early 1946 this industry will equal or exceed its pre-war rate of 4,000,000 a year. Smaller industries, as a rule, will be the fastest in reconversion. But even housebuilding may make a faster upturn than previously expected.

Materials

A TREMENDOUS IMPROVEMENT in the supply of most kinds of raw materials began to develop within a few days after the flood of war-end contract terminations and cutbacks started flowing from Washington.

"With a few important exceptions, most raw materials will soon be plentiful," the Snyder report said.

Outstanding in the size and quickness of the improvement will be most of the metals, except tin.

"In terms of materials, the Army cancellations will eliminate 99 percent of its steel, and 98 percent of its copper and aluminum consumption," Snyder said as a typical example of the effect of the war's end on previously shortage materials.

In its main categories, the outlook for supplies of raw materials is now as follows:

Steel. Production capacity now available is greater than any previous peacetime year. Even the actual rate of production is greater than the rate at which the rest of industry can *actually* use steel in the first stages of reconversion, but it will not be easy to match the production rate to the buying demand for the next several weeks, and to divide up shipments so that the flow of steel to users will smoothly match their production requirements. However, even the present production rate of sheet steel, which was a bottleneck in recent months to the resumed manufacture of many civilian items, is now greater than normal peacetime demand. In the first half of 1945, total output of sheet steel was approximately 5,680,000 tons, and the production in the second half will at least be as much. Practically all of this can be used for civilian goods. In comparison, civilian requirements for a half year in 1939 were only about 4,500,000.

Aluminum. Production rate is far in excess of any previous peacetime period, and capacity is considerably greater than the production rate. Immediate problem of aluminum industry is to develop expanded uses and users for its product. Much progress in this direction has already been made, and the industry now expects that the civilian markets will soon be receiving more aluminum products than ever before seen. No difficulty is expected in quickly meeting the raw metal requirements.

Copper and Brass. Here also the production rate of the metal producers is likely to exceed the rate at which the market will immediately require it. However, as with all the metals, wholesale and retail dealers' stocks are so low that even with a continuance of the high rate of production it will take some time before the shelves can be properly filled.

Zinc and Lead. Continued rapid increases in supplies for civilian needs will be forthcoming practically as rapidly as deliveries are needed.

Tin. The domestic stockpile is at very low point, while demand for tinplate will continue high. In spite of expansion of tin mining in non-war areas, and of expanded refining facilities, the restoration of adequate supplies of this metal must wait reopening of the tin mines in the Malay peninsula which were captured by the Japanese early in the war. Full-scale production from the Far East mines is not expected for about a year.

Lumber. Enough lumber for factory alterations should be quickly available; also for residential construction at about 50 percent of normal. Temporarily, a retardant on homebuilding will be the limited capacity of dry kilns, and depleted dealers' stocks. After about three or four months,

however, there should be ample supplies of lumber to permit housing construction to reach a rate of 400,000 units a year.

Textiles. Temporary surge of demands from returning veterans for civilian clothing will just about equal the previous drain on textiles for manufacture of uniforms, but some kinds of textiles will be available shortly in increased supply, and supplies in general will improve over a period of months. Increased manpower for textile mills will be an important factor. Immediate reduction of Army buying of textiles will be as much as 75 percent, according to the Snyder report.

Rubber. Output of synthetic rubber is now adequate for a reasonable splurge in new tires for automobiles and trucks, and for other industries which can use rubber in its synthetic or reclaimed forms. But stockpiles of natural rubber are low and will continue that way until damaged plantations in the Orient can be restored to production and transportation provided.

Fuel. Coal supplies will constitute a serious shortage for some months to come, but fuel oil and gasoline already are available in greatly increased quantities. The fuel oil supply, however, may tighten somewhat during the winter because of the certain scarcity of coal. Strikes of miners reduced coal production by about 13,000,000 tons since April 1, and about 6,000,000 tons is to be shipped to Europe before January 1. Furthermore, stockpiles of coal are at the lowest in years.

Federal Controls

ALL REMAINING WPB CONTROLS of industry will be removed "wherever immediate removal will help to get expanded production under way faster," the Snyder report to President Truman said.

Only 30 to 40 of the 650 original WPB controls remained in effect in the first week of peace, according to announcement by J. A. Krug, WPB Chairman. The only controls which have been temporarily retained, Snyder said, are those whose removal at this time "would bring a chaotic condition or cause bottlenecks or produce a disruptive scramble for goods."

Snyder's guiding policy was pronounced in these words: "The sooner we increase production, the sooner we can be rid of all controls."

Moreover, the Reconversion Director clearly showed that he is not a member of that school of thought which believes the whole economy can be completely and successfully "master-minded" from Washington.

"There is no place in our free economy for a master blueprint which will rigidly prescribe each move at every turn of the road," he said.

Snyder did not imply, however, that the OWMR or the WPB or other agencies which were set up primarily for essential wartime controls could escape the responsibility of making and enforcing policies for the guidance of industry during the reconversion period. These policies, he said, include restrictions on the use of some still-short materials, some lessened controls of prices and wages, and the use of priorities to assist manufacturers of highly needed civilian goods instead of leaving them to seek materials in a general scramble.

But with the foregoing exceptions of a temporary nature, Snyder showed it will not be the long-time purpose of OWMR to plot the course of industry's production. In contrast to war conditions, when the government "not only created the market but also specified exactly what kind, shape, and size its share of the nation's output would be," Snyder said, "Now that peace has come, *the American people as individual customers* will determine what business men and farmers are to produce. . . . Our peacetime goal of maximum production can be best attained by relaxing controls as early as the supply situation permits."

Only a few days earlier, President Truman had concurred with the basic views subsequently expressed by Snyder. Writing to WPB Chairman Krug, the President said, "It is necessary for WPB to continue for the present some of the effective measures it adopted to achieve our unprecedented war production," but added that these controls "should be lifted as soon as they are no longer needed."

The President's letter, coming after imminent defeat of Japan was assured, listed a five-point program for WPB:

1. A vigorous drive to expand production of materials which are in short supply . . .

2. Limitation upon the manufacture of products for which materials can not yet be made available . . .

3. A broad control of inventories so as to avoid speculative hoarding and an unbalanced distribution . . .

4. Granting priority assistance to break bottlenecks which may impede the reconversion process . . .

5. Allocation of scarce materials necessary for the production of low-priced items essential to the continued success of the stabilization program.

In specifying elsewhere in the letter that WPB's measures should continue under the guidance and direction of John W. Snyder as director of the Office of War Mobilization and Reconversion, it appeared that the President was following recent recommendations of the Mead War Program Investigating Committee, which Truman headed when he was a Senator. The committee proposed that the OWMR director be put in direct control "on a supervisory operating basis" over all war agencies, rather than functioning as "a conciliator" or "umpire."

Industrial Expansion

VAST NEW SIGNIFICANCE has been lent by recent developments to the important Department of Commerce report of July 31 on the plans of some 7000 manufacturers for expansion of facilities, inventories, and credits totaling $9,200,000,000. In addition, the railroads and utilities were found to be planning expenditures of $1,500,000,000 for capital goods and equipment. All of this outlay was scheduled for the coming 12 months at a time when it was assumed that the Japanese war would last that long. This is one of the brightest signs in the current picture. Its optimistic implications are heightened, rather than lessened, by the swift cessation of hostilities. For one thing, the products of most of the manufacturers involved have

changed but little in the war. The time element of "reconversion" by capital goods manufacturers will therefore not be great in most instances.

Moreover the purchasers of industrial and transportation equipment and supplies are more likely to increase, rather than decrease, their commitments under the urgency of sudden reconversion. This was predicted by D. Stevens Wilson who conducted the survey.

Even in cases where a considerable change-over is required, there is evidence of alert forward thinking by heavy goods manufacturers. For example, the Edward G. Budd Company, Philadelphia, was able to announce to its 9000 employees on the day following the Japanese surrender that there would be no cessation of work whatever. They were told to report for work immediately on a big backlog of peacetime orders for railroad equipment that would keep the Budd plants busy for at least a year.

Another welcome note of confidence was struck at the same time by Charles E. Wilson, president of General Electric, who announced that the company's peacetime outlook promised jobs for 150,000 persons, an average increase of 50 percent over its total wartime personnel.

On the basis of the Commerce Department survey, some government economists found indication of a gross national product of about $160,000,000,000 in civilian production. The 7000 manufacturers covered by the survey ordinarily account for about 40 percent of the country's annual capital formation and in 1939 accounted for 60 percent of manufacturers' outlay.

Surplus Property

GOVERNMENT AGENCIES in charge of the disposal of war surplus properties and goods began redoubled efforts with the end of the war to speed their several programs. With the total value running into many billions of dollars, however, it appeared that several years will be required before the bulk of these properties and goods have been sold.

Special efforts have been made, and are still being refined, to simplify as much as possible the purchase of surplus properties and goods. In many cases, a simple technique of buyer-and-seller bargaining is used; in others, there is the almost equally simple process of competitive bidding.

On this subject, the Snyder report said:

"A coordinated program has been worked out to get such surplus property into the hands of business and the public as soon as possible, at the same time avoiding disruption of the civilian supply economy. State and local governments, small business, and veterans, are receiving the priorities to which they are entitled by law.

"Through full cooperation between the war agencies and the RFC, under the guidance of the Surplus Property Board, provisions have been made for speedy disposal of government-owned plants and equipment."

Policy of the Surplus Property Board, as stated by its chairman, W. Stuart Symington, will be to handle disposals "from the standpoint of maximum employment." Symington also said he believed estimates of war surplus properties and goods at $100,000,000,000 were "a lot too high."

Symington offered no comment on the recommendation of President Truman to Congress that surplus property disposal should be placed under a single administrator instead of under the present three-man board.

Even before the capitulation of Japan, several scores of government-owned industrial plants had been offered by RFC for sale or lease, and others will be put on the market shortly. It remained to be seen, however, how many of these would have any value to civilian industry.

Small Business

THE SMALL BUSINESS MAN will continue to have his friends in court during the reconversion scramble. Said Snyder:

"The loan powers of the Reconstruction Finance Corporation and the Smaller War Plants Corporation are available to small business... The government is providing positive aids to small business during the transition period. Priorities now granted to small business firms will continue in effect until September 30. Thereafter, in granting priorities to break bottlenecks, the WPB will give special attention to bottlenecks affecting small firms.

"The SWPC has a government priority enabling it to buy surplus equipment and materials for resale to small business and will aid any small business man in locating surplus property which he needs. These aids will also be extended to veterans."

Additionally the Department of Commerce is making plans for channeling its services more directly to the needs of small companies. A vast clearing house of business information—on markets, products, and administration—Commerce can help many small operators in making their plans and running their businesses if the way can be found to get its material systematically into the hands of the right men at the right time.

Casualties are nevertheless likely to be high among representatives of a certain type of small industrial company, especially those who began the war as side-street shops with 10 or 20 employees and mushroomed overnight into organizations of 200 or 300. Since this expansion was based on war work alone, some will have a hard time finding customers in the competitive market. Many have let their costs and wage structures get completely out of line with reality, as they will learn when they try to outbid others for a competitive job.

Terminations

LONG BEFORE THE JAPANESE SURRENDER, we had amassed a volume of experience in handling contract terminations that left the way well cleared for the final wave of cutbacks. Already 150,000 cancellations with a face value of $22,000,000,000 (more than four times the total for the entire First World War) were out of the way.

Consequently, Snyder was able to speak with well-based optimism on the outlook for speedy and efficient disposal of termination problems. He pointed out that the Office of Contract Settlement was already geared to a big volume of work and that 30,000 contractors had had some education in termination procedure. Moreover, the great bulk of the last huge batch of cancellations affected orders that were merely "on paper" anyway.

Thus one factor, which potentially might have hamstrung the whole reconversion process, was dealt with by the careful planning and preparation which began in WPB, the War and Navy Departments, and the Maritime Com-

mission about 18 months ago. Contractors won't find it hard to get quick cash, apparently. In an earlier report, July 2, OCS stated that only two of the partial payment claims on its books were more than 30 days old. On the average, Army contractors were collecting about 39 percent of their claims in advance payments.

Planning

WHEN CONGRESS RECONVENES, the Murray "Full Employment" Bill will hold the center of the Washington stage.

Back of the bill is a strong combination of CIO-liberal-leftist supporters. Spearhead of the group in the Senate is Senator Harley Kilgore, West Virginia Democrat. Introduced by Senator Murray of Montana, the bill would provide for large government expenditures at any time private employment falls below a certain level.

Many of the bill's less radical sponsors sincerely believe that it would be an aid, rather than a hindrance, to private enterprise. Some of its more socialistic supporters, however, appear to concur with its conservative critics in viewing it as an attempt to introduce the basically socialistic principles of the British Labor Party into the American economy.

This is the main reason why predictions differ so radically as to probable unemployment. The strategy of the liberal-labor group is to depict the future in the blackest possible terms, and hence, inferentially, to build support for "full employment" on the ground that government intervention is the only thing that can save us.

Kilgore was on record with a dire prediction of economic woe even before the Japanese surrender. CIO's Sidney Hillman followed up promptly with a bleak forecast of 10,000,000 unemployed. And the New York liberal newspaper, *PM*, began a campaign on August 18, with a front-page headline: "While Washington fumbles, 10,000,000 face loss of jobs."

Prices and Wages

IN ONE OF THE MOST SIGNIFICANT COMMENTS of his August 16 report, Snyder observed:

"The United States will be faced with the forces of both inflation and deflation in the coming months."

Hence, he announced, rents will be held in line and price ceilings will be maintained on certain materials which remain in short supply. The specific list of articles removed from price control proved, however, to be very small when announced by OPA. It applied only to consumer goods which do not enter "significantly" into the cost of living, such as sporting goods, cameras, certain unimportant types of household goods and furniture, luxury furs, and jewelry.

One of industry's principal headaches—the squaring of prices with OPA policy—thus remained, at least until the law of supply and demand could assert itself. And a good lively argument began to shape up between those who feared high prices might ruin the demand for goods and those who feared that price controls might discourage many manufacturers from attempting to enter the market.

Snyder did make clear his recognition of the fact that price and wage control were inextricably related.

"While price and rent ceilings remain in effect," he said, "wage stabilization must be continued. Wherever price ceilings will not be endangered, collective bargaining will be restored. Wages and price increases will be allowed to correct substandard pay scales, to relieve hardships of individual workers and enterprises, and, where necessary, to stimulate increased production."

How these intricate principles were to be effected, he did not say. An announcement from the War Labor Board was awaited. But it became clear that minimum wages would be floored up, possibly to the 65-cent line. And there was a hint that later on some attempt might be made to stop the fall of prices in certain materials in which a pronounced oversupply develops.

Post-War Manufactures and Jobs

In its study of post-war markets and jobs, digested here, the Committee for Economic Development selected 1947 on the assumption that it would be the first full year after victory. With the coming of world peace, however, the findings are applicable with almost identical accuracy to 1946.

THE TOTAL NUMBER of civilians who will want jobs in the first full year after victory over Japan will not exceed 54,000,000.

There will be between 51,000,000 and 57,000,000 civilian jobs available to offer them. The most likely number will be about 53,500,000.

Output of the manufacturing industries will amount to $80,515,000,000, based on 1939 prices.

Manufacturing industries will provide steady jobs for approximately 13,469,000 people.

These are the main conclusions from a nation-wide business survey conducted by the Marketing Committee of the Committee for Economic Development. *They are based on industry's own estimates of post-war production and employment.* Added together they offer convincing evidence that the national economy in general and the manufacturing industries in particular are headed toward the

Table I. Civilian Jobs Needed — Estimates for 1947
(in millions)

	Predictions Range From	To	CED's Best Guess
Total Labor Force	58.2	62.0	60.0
Armed Forces	—4.0	—2.0	—3.5
Civilian Labor Force	54.2	60.0	56.5
Permissible "Labor Float"	—4.0	—1.5	—2.5
Needed Civilian Jobs	50.2	58.5	54.0

highest peacetime levels in American history.

The procedure by which the conclusions were reached and the reasoning upon which they are based, are as follows:

Estimates by hundreds of industrial leaders and trade associations indicate that—based on 1939 prices—the dollar volume of manufacturing industry in 1947 will be $80,515,000,000 compared with $56,843,000,000 in 1939—a gain of 41.6 percent.

Jobs Gain, Too

Then, taking into consideration the probabilities that the hours of the average employee's work week will be about the same in 1947 as in 1939, and that worker productivity will be about 6 percent higher, the analysis indicates that manufacturing—on the basis of a 41.6 percent gain in output—will provide steady jobs for 13,469,000 employees—an increase of 34 percent over the 1939 figure.

Past records of the Bureau of Labor Statistics show that there is a relationship between number of employees in manufacturing and total number employed in the whole economy. In short, the number of employees in manufacturing in 1947 would represent 25.2 percent of the total of all civilian employment in the nation. On that basis, the grand total of employment would be 53,448,000—within 500,000 of the number needed.

The Big Question

Key question for which the committee sought full answer was: How many persons *should* be employed in 1947?

In 1929 the labor force—the whole body of persons working or seeking work—included 48,060,000 persons. By 1939 the number had grown to 54,106,000. The 1929 total represented approximately 39 percent of the nation's population; in 1939 it was approximately 41 percent of the population. The 1944 labor force was computed at 64,010,000—roughly 46 percent of total population.

For 1947 the labor force will range from 58.2 to 62.0 millions (Table I), with 60.0 millions in the labor force the "best guess." Estimates of the number in the armed forces range from 4.0 to 2.0 millions, and estimates of the permissible "labor float"—persons moving from job to job or otherwise temporarily unemployed—range from 4.0 to 1.5 millions. These factors indicate that between 50.2 and 58.5 million jobs will be needed for the whole economy, with 54.0 million the most reasonable sum. This represents an increase of 20.3 percent over the figure for 1939.

As a further check on the estimate of 60.0 millions in the labor force, the Census Bureau's estimate of the normal labor force was taken for the last week of March, 1947—57.7 millions. To it was added 1.3 millions to allow for members of the armed services not counted in the bureau's 57.7 figure, also for seasonal workers and some others. Next 500,000 estimated war casualties were subtracted, and 1,500,000 persons were added as an estimate of employees who will be retained under the *abnormal* conditions of semi-war as contrasted to the bureau's figure.

Heads of individual companies and of trade associations were then asked to forecast the output of their respective industries in 1947, based on 1939 prices. Results based on a total of 1564 answers are shown in Table II.

All of the 20 main groups reflected confidence in considerable increases in volume of business. Biggest gain anticipated is in automobiles and automobile equipment—75.8 percent. The lowest percentage of increase estimated is still a healthy 22.3 percent—in leather and leather products. Average

Table II. Industrial Output — Estimates for 1947

INDUSTRY*	Value of Manufactures at the 1939 Price Level (millions of dollars) 1939	Estimated 1947	Percent Estimated 1947 Increase Over 1939
NON-DURABLE GOODS			
1. Food and kindred products	$10,618.0	$14,185.6	33.6
2. Tobacco products	1,322.2	2,240.0	69.4
3. Textile and fibre products	3,930.7	4,997.9	27.2
4. Apparel and other fabric products	3,325.0	4,136.3	24.4
7. Paper and allied products	2,019.6	2,579.3	27.7
8. Printing, publishing, and allied industries	2,578.5	3,359.8	30.3
9. Chemicals and allied products	3,733.4	5,907.3	58.2
10. Petroleum and coal products	2,954.0	4,023.5	36.2
11. Rubber products	902.3	1.329.2	47.3
12. Leather and leather products	1,389.5	1,699.3	22.3
TOTAL NON-DURABLE	$32,773.2	$44,458.2	35.7
DURABLE GOODS			
5. Lumber and timber basic products	$1,122.1	$1,412.8	25.9
6. Furniture, finished lumber products	1,267.7	1,872.5	47.7
13. Stone, clay, glass products	1,440.2	2,062.6	43.2
14. Iron, steel, and their products except machinery	6,591.5	9,052.4	37.3
15. Nonferrous metals and their products	2,572.9	3,710.1	44.2
16. Electrical machinery	1,727.4	2,698.3	56.2
17. Machinery, except electrical	3,254.2	4,961.1	52.5
18. Automobiles and automobile equipment	4,047.9	7,117.6	75.8
19. Transportation equipment except automobiles	882.9	1,539.1	74.3
TOTAL DURABLE	$22,906.8	$34,426.5	50.3
20. Miscellaneous industries	1,163.0	1,630.3	40.2
GRAND TOTAL (all manufacturing industry)	$56,843.0	$80,515.0	41.6

(*) *Item numbers are the same as designations used in the 1939 U.S. Census of Manufactures*

Table III. Civilian Jobs Available — Estimates for 1947 (in millions)			
	Predictions Range From	To	CED's Best Guess
Civilian Jobs Needed	50.2	58.5	54.0
Civilian Jobs Available	51.0	57.0	53.5

for all industries is 41.6 percent. Average for all durable goods is 50.3 percent; for non-durable goods, 35.7 percent.

To translate dollar figures into terms of employment, the amount of change in rate of productivity was taken into consideration. The increase from 1929 to 1941 averages about 3 percent a year, compounded. In fact, the annual rate of increase between 1909 and 1941 also averages around 3 percent, compounded, excluding the period during and immediately after the last war.

Lower Man-Hour Output

Output per man-hour is not definitely known for the present war period. Apparently 1941 was the high point, with a decrease each year since then in industries that have continued in civilian goods production.

"Our judgment," to quote the report, "is that by 1945 output per man-hour in manufacturing will have dropped nearly to the level of 1939. Our feeling is that 1946 will see productivity at about the 1945 level. If 1947 is the first post-war year, as assumed by the estimators who aided in this study, we feel that output per man-hour in manufacturing in that year will increase above the 1945-6 level and *will be about 6 percent above the 1939 level.*"

Average number of hours per worker, the report indicates, will be about the same as in 1939. Thus the total number of workers in 1939 divided into the dollar value of 1939 output shows an average output per employee of $5640. In comparison, 1947 output per worker, figured at 1939 prices, but with 6 percent increase in productivity, will be $5978.

"If this assumption is realistic, and if the value of manufactures totals $80,515,000,000 at 1939 prices," the report points out, "manufacturing in 1947 will employ 13,469,000 persons, excluding the self-employed." This total employment represents an increase of 33.6 percent over 1939.

At this point the committee sounds a note of caution:

"The question of productivity per worker or per man-hour is very controversial, and it is actually perfectly possible to make out a rather good case for any one of a number of other points of view. Suppose that the increase in productivity per man-hour were, say, 12 percent, instead of 6 percent; manufacturing employment would be about a million less. Or suppose there were no increase in hourly output; manufacturing employment would rise to 14,276,000." (While the foregoing statement is correct mathematically, it should be remembered that, as productivity per man-hour rises, unit cost of product decreases, sales price decreases, volume of sales increases, volume of manufacture must increase, and total employment is likely to increase.—Ed.)

To interpret its estimate of 13,469,000 persons employed in manufacturing in 1947 in terms of employment in the economy as a whole (Table III), the committee takes note of the fact that manufacturing activities during the period from 1929 through 1940 accounted for 18 to 23.4 percent of all civilian employment. With gradual conversion to war production, the percentage rose to 32.3 in 1943; in 1939 it amounted to 22.5 percent of total civilian employment.

Percentage Rises

The committee further notes as significant that manufacturing employment's percentage of all civilian employment tends to rise to a higher ratio when all employment is high, and tends to fall to a lower ratio when all employment is low.

Taking into consideration all these related factors, the committee concludes that manufacturing employment in 1947 will be 25.2 percent of total civilian employment. On that basis, the employment of 13,469,000 persons in manufacturing, excluding the self-employed, indicates "the total number of employed civilians might be about 53,448,000."

Again the committee warns:

"It is possible to argue rather convincingly for other conclusions as to the probable ratio of manufacturing employment to total civilian employment. How different the result would be if some other ratio than 25.2 percent were to be accepted, can be seen from the fact that a change of only 0.5 percent in the ratio produces a change, up or down as the case may be, of about one million persons in the civilian employment total."

Best Guesses for 1947

The summary of most reasonable specific expectations for 1947, correlating value of manufactures, employment in manufacturing, and total civilian employment is shown in Table IV.

"In our opinion," the committee sums up, "the truth of this matter may best be expressed as follows:

"Starting with business's own estimate of the value of manufactures in 1947 ($80,515,000,000 based on 1939 prices)—

"Our best (and very rough) guess as to the attendant level of total civilian employment is around 53.5 millions.

"Actually civilian employment anywhere between 51 and 57 millions would be entirely possible and reasonable if the value of manufactures reached the indicated level.

"On this basis, we have a clear and strong foreshadowing of an excellent first post-war year for both business and employment."

Table IV. Output and Employment — Estimates for 1947			
	1939 (millions)	Estimate 1947 (millions)	Percent Increase
Value of Manufactures (1939 prices)	$56,843.0	$80,515.0*	41.6
Employment in Manufacturing	10.1	13.5	33.6
All Civilian Employment	44.9	53.5	19.1

** A summary of estimates provided by 1564 industrial companies and trade associations*

FACTORY MANAGEMENT AND MAINTENANCE

L. C. MORROW, EDITOR

Fifth Annual National Production Issue

The Time for Low Production Costs Is Now

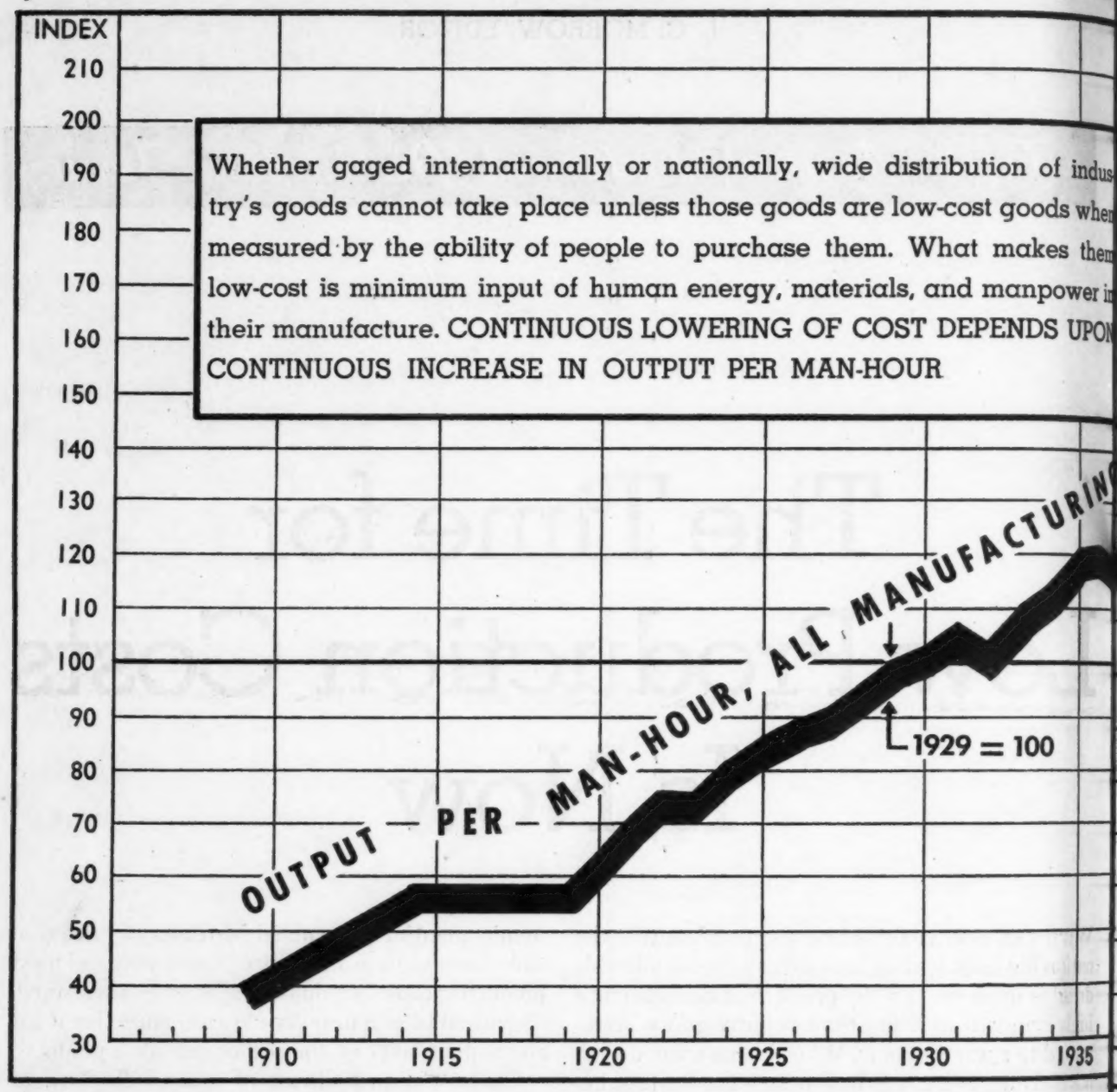
WITH THE DEFEAT OF JAPAN, the problem that the nation has been looking forward to with considerable dread is upon us. It is the problem of maintaining a high standard of living for a country grown accustomed to a war economy. Whoever has wanted a job has had one. Wage rates have been high, overtime has been plentiful, and take-home pay has been abundant. For much of industry there has been but a single customer, the government, and reimbursement for costs has been assured, with a good chance for profit.

As soon as the fall of Japan was certain, cancellations of war orders were immediate. Because the flow of war goods into the Pacific pipelines has ceased, employment has been reduced, and practically all plants are resuming production of peacetime goods.

In the near future there will be shortages in scarce materials. There will be profits for some manufacturers because there will be plenty of purchasing power to absorb their products, but losses for others because they will not be able to produce in the economic quantities demanded by reason of price controls. Immediate availability of the newest and most productive capital equipment is by no means assured. Organized labor is disinclined to recognize that it has any responsibility for the cost of industry's products.

Contrast the conditions of today with those of recent years. In 1940 the nation was groping its way toward the application of some of its resources and some of its energy to defense. War was remote, though recognized as a possibility. In 1941, up until December 7, we still were producing for defense, but there was no doubt that war was inevitable, and the nation was almost frantically engaged in turning out war matériel. Time meant everything, cost nothing. That year $19,000,000,000 worth of war goods were made, but Donald Nelson was calling for $6,000,000,000 worth per month in 1942 and 1943. Cost in dollars still was not important in 1942, but conservation of manpower and materials was becoming necessary. In 1943 the staggering financial burden plus the serious shortages in manpower and

THE ONLY WAY OUTPUT PER MAN-HOUR

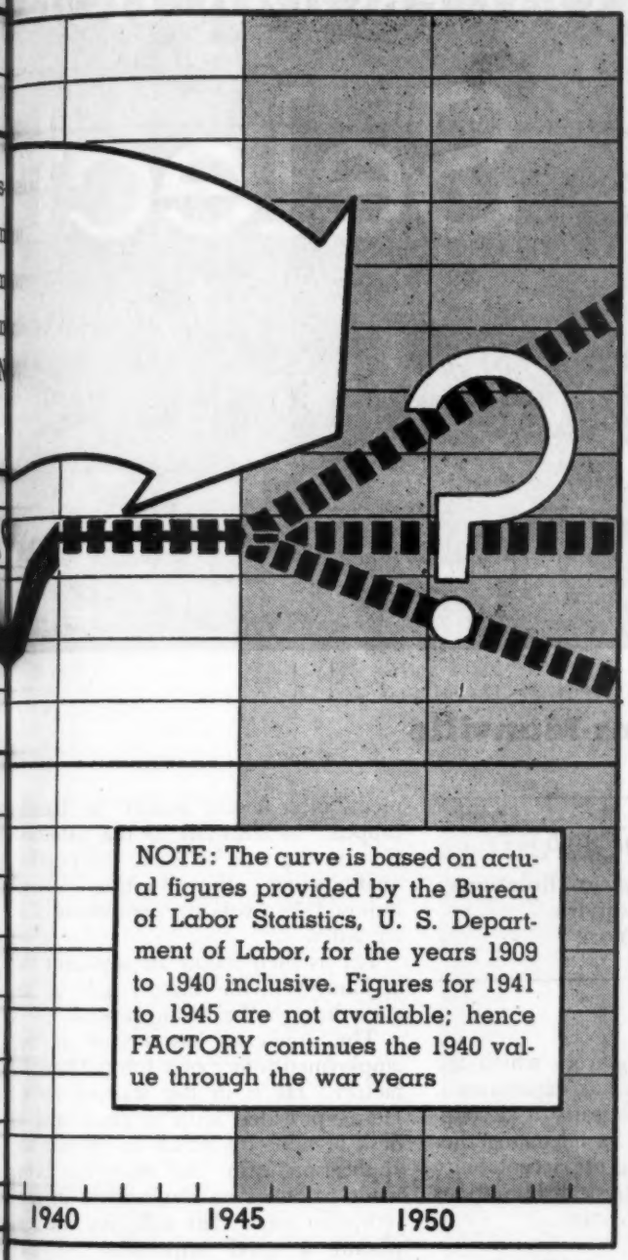


materials were demanding efficiency in manufacture. Last year, 1944, the world picture had become clear and as part of it America's obligation in matters of rehabilitation and reconstruction—an obligation that could not be properly filled unless contributed to greatly by efficient, wasteless, low-cost production.

This year's conditions, caused by the war but brought into new focus by the advent of peace, are tremendously complicated. Employment obligations hitherto unexperienced are upon us. The nation has become accustomed to the expectation of new and higher standards of living. The end of the war has given us a true picture of devastation and starvation. It has enabled us to sense the terrific drain upon our resources and our abilities that is ahead. It has enabled us to see that the wide distribution of industry's goods as well as farm products is essential to a satisfactory world-wide economy.

Whether gaged internationally or nationally, wide distribution of industry's goods cannot take place unless those goods are low-cost goods when measured by the ability of people to purchase them. What makes them low-cost is minimum input of human energy, materials, and manpower in their manufacture. Only America has developed the required procedures to the extent necessary for immense production while paying wages and other costs that would be prohibitive in any other country. Only America

SHOULD GO IS UP



NOTE: The curve is based on actual figures provided by the Bureau of Labor Statistics, U. S. Department of Labor, for the years 1909 to 1940 inclusive. Figures for 1941 to 1945 are not available; hence FACTORY continues the 1940 value through the war years

can apply effectively the following ten procedures, which are the keys to the low-cost production needs of today:

1. Select the right workers. There are and will be more people wanting work than ever before in our history. To make sure of getting workers that will be fitted to specific jobs, careful methods of selection and induction are called for.

2. Train employees to do the job. Training will bring about effective application of the abilities and aptitudes of employees pointed out by the selection procedures.

3. Adopt the best in layout. Arrangement of production equipment to prevent idle time of machines and lost motion by employees is essential.

4. Use the most effective handling. Full benefit of good layout cannot be secured unless handling methods and equipment are right.

5. Practice work simplification. Everything progresses in the progressive plant. Layout, handling, processing that are good today can be improved tomorrow. Simplification is a continuous procedure when properly applied.

6. Plan and control production. No plant ever gets very far along the road to low-cost production unless it makes use of good planning to say what and how much is to be made when, and good paperwork to make certain the planning is being practiced.

7. Make the plant a good place to work. With poor working conditions, much of the effort put forth in selecting and training employees, in making layouts and setting up for handling, in simplifying work, and in planning and controlling production could be nullified.

8. Evaluate jobs and pay accordingly. It is the modern way. It treats everybody alike. It can be understood by labor and management both, and, if need be, by labor boards.

9. Keep equipment and plant in condition. It means good maintenance, with emphasis on prevention instead of repair, and with maintenance policies set by people with enough authority to make them stick.

10. Provide management controls. Executives must know that procedures 1 to 9 are being followed. Management by exception will do it. Let the controls tell management when things are wrong, say nothing when things are right.

This issue of FACTORY presents a case application of each of the ten procedures described above. No abstractions. No philosophizing. Just how-it-is-being-done reports. It is our hope and our certain conviction that these tested cases from ten units of American manufacturing industries will help many of the host of other units toward a fuller accomplishment of that low-cost production which we believe is a paramount requirement of the present and the future. The time for low production costs is now.

TO INSURE LOW-COST PRODUCTION

1 Select t

Case of Johns-Manville

J. P. WOODARD
Director of Industrial Relations
Johns-Manville
New York

ALTHOUGH MOST JOBS in Johns-Manville factories do not call for highly specialized skills, the need for selecting the right workers and putting them on the jobs for which they are best suited, is recognized by management as the first step toward achievement of low production costs.

These are not days when an industry can pick and choose. For the most part, with almost all types of labor still in short supply, it takes pretty much what it can get. At Johns-Manville's mine and factory locations, psychological testing—with which the company has been experimenting for a number of years and will install when proved practicable—is being held in abeyance in favor of interviews designed to weed out the not-so-obvious misfits and an induction and job training program aimed at orienting the new employee in the shortest possible time and making him feel he is really a part of the organization.

As far as possible, standard practices have been set up. For the purposes of this article, a resumé of these practices is given, together with the reasons for their inclusion in the planning of the industrial relations program.

The recruitment of men and women to work in the JM factories follows the usual lines. Each location recruits workers in accordance with requisitions for employees which are submitted by its various departments.

These requisitions carry a description of each job to be filled, together with data concerning the acceptability of workers with physical limitations for it—if such is the case.

Recruits Obtained From Five Main Sources

With these requisitions in hand the industrial relations department seeks recruits from: (1) Present employees who could be transferred; (2) files of laid-off employees; (3) persons recommended by present employees; (4) former employees; (5) public and private employment agencies, schools, veterans' associations. If none of these proves productive, newspaper ads and various other mediums are used, depending on the nature of the job to be filled and local conditions.

It is proper to underline here the importance of adequate job description data, without which the employment interviewers would be handicapped. In addition to the information on the type of work, the positive qualifications, the limiting factors imposed by working conditions also are listed.

Let us then follow an applicant for a Johns-Manville factory job as he goes through the hiring process.

The applicant has arrived at the employment office of a Johns-Manville factory. He is in the waiting room. He is provided with a chair and a desk or table on which to fill out his application form. An effort has been made to create an atmosphere in this reception room that will give the applicant a good impression of the company. First impressions are considered important.

His first contact at the employment office is with a representative of the industrial relations department—the employment interviewer. This individual has been selected because he possesses primarily an ability to meet people and to get along well with them, to engender confidence. He also has been thoroughly trained.

The applicant is first given an application blank, then instructed how to fill it out. Any assistance he may require is volunteered and cheerfully given. In addition to the usual facts —name, address, and so forth—this blank seeks to ascertain information concerning his personal background,

the Right Workers

his educational attainments, past work experience, his job preference, and the wages he expects.

With the filled-in form to guide him, the employment interviewer proceeds with the personal interview, which is conducted in private. In this interview it is possible to get a reasonably complete picture of the applicant's capabilities and something of his personal characteristics. It is also possible to bring out any unusual abilities or characteristics the applicant possesses which might direct him into some other, better job, if such an opportunity is open.

The trained and observant interviewer is able to detect also any adverse characteristics that might make the applicant unsatisfactory and disruptive to the organization.

Adverse Characteristics Detected in Interview

Aside from the accumulation of necessary data concerning the applicant, there is another objective constantly in mind. Whether or not the new man eventually comes into the organization, he is forming an opinion of the company that is going to remain with him and, experience has shown, is very rarely basically changed, even after months on the payroll.

On the other hand, should the applicant be found not suitable for

A skilled interviewer is frank and friendly, puts the applicant at his ease in the private interview that precedes employment

employment, it is important that he leave the interview with a good opinion of Johns-Manville, because there is no telling what effect his impressions and ideas might have on some other persons who might subsequently consider coming to work at that plant.

Lasting impressions of the company's fairness and sincerity, and of the factory management's attitude toward its employees, are generated in this first interview. Consequently a large part of the interviewer's training is directed toward the objective of creating the best possible impression on the applicant.

At the conclusion of this first meeting the interviewer has decided that this applicant fulfills all the requirements of a particular job. He is then told that he must undergo a fairly rigid physical examination. The reasons for the examination and the benefits that derive, both to the company and to the man himself, are carefully pointed out. The appointment for the examination is made and the papers—the application and the job description—are forwarded to the medical examiner.

Physical Examination a Searching One

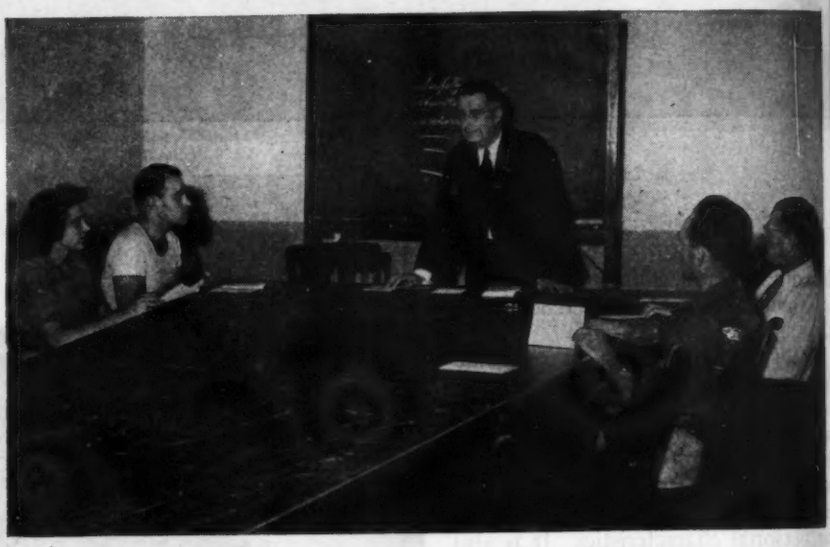
In the smaller JM factories these examinations take place at the office of a local physician who is employed on a retainer basis for this purpose. In the larger factories the examinations take place in the dispensary. The physical examination is a searching one. In addition to the usual eye, ear, heart, teeth, and general physical conformation data, urinalysis and the Wassermann or Kahn test are initiated, and complete chest X-ray plates are exposed.

The purpose of the physical examination is not only to determine whether an applicant meets JM's standard physical qualifications, but also to aid the interviewer in placing applicants with physical limitations, when jobs on which these individuals can be used are available.

The results of the physical examination and the findings of the laboratory are included in the medical report and all data are returned to the employment office.

Having passed his physical examination and proved satisfactory in his first interview, the applicant is advised that he has been hired for a probationary period of two weeks, and is instructed to report for photographing and fingerprinting. The probationary period allows for laboratory tests to clear and also tests the individual under actual work conditions.

The pre-employment physical examination is unusually thorough, includes blood pressure, chest X-ray, Wassermann, urinalysis



All new employees are told about Johns-Manville's history, policies, rules, safety program, and benefits by a plant training supervisor

Before he goes on the job, the new worker is introduced to, and welcomed by, the plant industrial relations manager

Escorted by a plant guard, new worker meets his departmental superintendent, who chats informally, tells him about the work in general

As an important part of his induction, foreman makes sure that the new man is introduced to all the other men in his section

Instruction on the job for which he has been hired is given by the foreman, who emphasizes the why's and wherefore's of safety rules

Psychological tests of a prognostic nature are not at this time part of the standard employment practices at Johns-Manville, although much thought and study have been given to these new selection tools. Given impetus by the testing programs for classification in the Army and Navy, such tests may shortly become regular employment aids.

Tests Scheduled for Post-War Use

These tests include intelligence, and aptitude—mechanical, clerical, arithmetic—and another grouping of personality and interest inventories that could all be lumped together and called "compatibility" tests. The value of compatibility tests in industry is highly controversial. Johns-Manville feels the burden of evaluating the applicant in the fields covered by these tests must be borne by the employment interview. Johns-Manville so far has done nothing beyond experimental work in the prognostic testing field at the employment stage in plants and mines. It is hoped that JM's experiments will result in reliable batteries and norms so that validated prognostic tests can become part of the selection machinery. The ultimate would be several batteries with varying norms, depending upon the jobs in question, which could be used as effective tools in screening candidates for both skilled and unskilled jobs.

When and if such batteries are available, there will still remain the extremely important task of selecting competent people to administer and evaluate the tests and correlate the results. Experts have advised, and the company's limited experience confirms, that the best selection tests, administered by pseudo-experts, can be and are damaging to the future of all testing.

Until such time as prognostic tests are completely validated for JM's purposes, only achievement tests that gage realized ability, measured by performance, will be used in selecting new employees. Beyond the employment field, some prognostic tests are used to select present employees for further training, particularly supervisory training. In all such cases, however, those being tested are employees about whom other specific personal and performance data are available, both in personnel and production department files.

The induction of the new jobholder is handled by another representative of the industrial relations department, who also has undergone special train-

ing for his duties. In many cases it is carried out by the training supervisor and his staff.

First the applicant signs his employment card and the necessary payroll and government forms. He is then assigned a clock number and given a temporary pass and "Job Instruction Assignment" slip. With these out of the way, the inductor sits down with the new employee or a group of new employees for what may be termed the induction talk.

The purpose of this discussion is to give the new employee as comprehensive a picture as possible of Johns-Manville. The inductor goes briefly into the company's history—how it started, and the reasons for its expansion. He attempts to explain the background and the reasons for the company's basic policies as they relate to employment, and its attitude toward employees. The over-all policies of the company also are dealt with. The degree of detail into which this part of the induction talk is carried quite naturally depends on the type of job for which the applicant has been hired, and his ability to assimilate this information. Some men are more interested in such an exposition of history and policies of the company than others. This very quickly develops from the questions the new man asks.

Company Policies Explained

The position that the particular JM factory occupies with reference to the whole company is carefully explained. The nature of the materials manufactured at the plant and their uses are outlined. The employee is given a booklet also, "Things You Need to Know About Your Job," which contains a clear, simple explanation of the company's policies, and the various company benefits.

Company benefits are explained next. They comprise a retirement plan, group life insurance, group health and accident insurance, and the hospitalization plan. The credit union and the various social and athletic activities are explained, and an invitation is extended to the new employee to participate in them. At all factories where the employees bargain collectively through the medium of a labor union, a copy of the union contract is given to the new employee.

At this time the details of rationing, car pools, and other transportation matters are discussed. Whenever possible car pools are arranged.

An important phase of the induction talk deals with safety. The company's whole safety program is explained, including intra- and interplant safety contests. In addition to the general rules for safety, and the particular ones that apply to the individual factory, a safety booklet is given to the new employee. This booklet points out safety "do's" and "don't's" and emphasizes the protection afforded by goggles, safety shoes, respirators, and other accessories. An additional explanation of special rules and precautions is given if the new employee is a woman. They are covered also in additional literature which is presented at this time.

New Worker Made to Feel at Home

The induction talk finished, the new employee is welcomed by the industrial relations manager. This brief interview is for no other purpose than to make the newcomer feel at home and to impress on him that he will receive friendly, fair treatment in the future.

Before he is taken by a representative of the industrial relations department to the department in which he is going to work, the new employee is instructed to return to the employment office in two weeks to receive his permanent identification badge. This is a definite invitation; a specific time is set. The objective of this second interview is not wholly to receive the badge, but to afford the interviewer an opportunity to talk again to the new employee; to find out how his new job is going; how he likes it and those associated with him. If any misunderstandings have developed during this two-week period, this second interview offers an excellent opportunity to clear them up.

Mention should be made, at this point, of another effort on the part of factory management to welcome the new employee into the force. In addition to the welcome he has received personally from the industrial relations manager a letter from the factory manager is sent to his home. This is a friendly letter, which, it is anticipated, will be read by the new employee's wife or some other members of the family. The object is to bring not only the new employee, but also the members of his immediate family, into this slight, but positive, contact with the company. The letter seeks to create the wholly legitimate impression that the company is interested in its new employee and anxious that this newly formed association will be advantageous to all concerned.

Resuming the description of induction procedure—the new employee is now escorted to the department in which he will work. This is called the "induction into department."

In the department he is introduced to the superintendent. This introduction places special emphasis on the necessity for getting the new man's name correctly pronounced and thoroughly understood.

The superintendent then explains the work of the department, and gives more details as to the character and uses of the products made. He also goes very carefully over the safety rules pertaining to his department and makes certain that the new employee reads his book on safety and signs the slip on the last page, as evidence that he has read and understands its contents. This re-emphasis on safety is regarded by Johns-Manville as particularly important. Consequently, the safety record of the department and its standing in the intraplant competition is impressed on the new man.

Any questions are answered, after which the superintendent takes the new man to the section of the department in which he will work and introduces him to his foreman. The foreman conducts the "induction into job."

The foreman shows the new employee where he can find the locker room, washroom and toilet facilities, drinking fountain and salt tablets, soft drink and candy dispensers, smoking area, lunch facilities, tools, equipment, and material. He also tells him how to get tools, equipment, and material, and what to do to obtain first aid treatment.

The new employee is then told how his pay is figured, his days of work and his shift hours, his lunch period and relief periods, and the possible lines of progression within his group or in the department.

Introduced by Foreman to Fellow-Workers

Next the employee is introduced to the timekeeper and shown how to punch his clock card. The foreman also introduces the new employee to those with whom he will work—making sure he pronounces all names correctly. Joe Doakes is Joe Doakes and he hates to be called Joe Stokes!

Any questions that arise are answered, and any rules or regulations needing emphasis are reviewed.

Now, depending on the character of his job, either the foreman or a job instructor takes the new employee in hand for specific job instruction. The manner in which the new man takes hold of his job and the compre-

JOHNS-MANVILLE

PERSONAL RECORD

DATE_____

POSITIONS PREFERRED_____ SALARY DESIRED_____ SOCIAL SECURITY NO._____

_____ SALARY DESIRED_____

_____ " _____ WHEN CAN YOU START WORK?_____

NAME (PLEASE PRINT)_____
LAST FIRST MIDDLE

PHONE· HOME_____

ADDRESS_____ " BUSINESS_____
STREET AND NUMBER CITY POSTAL ZONE STATE

SEX_____ AGE_____ DATE BORN_____ PHYSICAL HANDICAPS_____

MILITARY SERVICE STATUS_____

HEIGHT_____ WEIGHT_____ SINGLE_____ MARRIED_____ WIDOW(ER)_____ SEPARATED_____ NO. OF DEPENDENTS: CHILDREN_____ ADULTS_____

U.S. CITIZEN_____ OWN YOUR HOME_____ LIVE WITH YOUR PARENTS_____ FATHER'S OCCUPATION_____ FATHER'S EMPLOYER_____

HAVE YOU WORKED FOR J-M BEFORE?_____ FROM—TO_____ WHERE_____ DEPT._____ NAME OF SUPERVISOR_____

NAME ALL RELATIVES OR ACQUAINTANCES IN J-M

WHO REFERRED YOU TO J-M?

EDUCATION	NAME OF SCHOOL	ADDRESS	YEARS	COURSE AND MAJOR	YEAR GRAD.	DEGREE
JUNIOR HIGH						
SENIOR HIGH						
COLLEGE						
BUSINESS						
OTHER SCHOOLS AND SPECIAL COURSES						

FOREIGN LANGUAGES—SPEAK_____ READ_____ WRITE_____

MACHINES OPERATED_____ _____ _____

(HOW LONG EACH)_____ _____ _____

PRESENT SPEED AND HOW LONG USED—STENOGRAPHY TYPING

CHARACTER REFERENCES (OTHER THAN RELATIVES OR CASUAL ACQUAINTANCES)

NAME	FULL ADDRESS	OCCUPATION

EXPERIENCE RECORD LAST POSITION FIRST . . . CONTINUE OVER. INCLUDE **MILITARY SERVICE RECORD**

FROM_____TO	NAME OF COMPANY AND NATURE OF BUSINESS	ADDRESS STREET CITY STATE	POSITION(S) HELD AND CHIEF DUTIES	MONTHLY EARNINGS	REASON(S) FOR LEAVING

ACCORDING TO MY BEST KNOWLEDGE THE ABOVE IS TRUE

SIGNATURE OF APPLICANT:_____

Application blank given to all job-seekers at Johns-Manville is planned to ascertain information concerning personal background, educational attainments, work experience, and job preference

hension and initial dexterity he displays are carefully noted on his card. These impressions are important in determining his fitness for the job.

From this point on, and throughout his association with Johns-Manville, this worker will be under reasonably constant observation and training.

At the end of his first two weeks on the job he returns to the industrial relations department on company time to keep his appointment for his second interview. After he has been given his permanent identification badge he talks to the same person who interviewed him originally.

At this second meeting the employee is told more about the Johns-Manville retirement plan, and advised that he will be eligible to participate after he has completed two years with the company. As added incentive to stay with JM, he is told about the Quarter Century Club. Members of this 25-year service club are to be given an extra week's vacation each year after the war ends, and cannot be separated from the company without the approval of the president of the corporation.

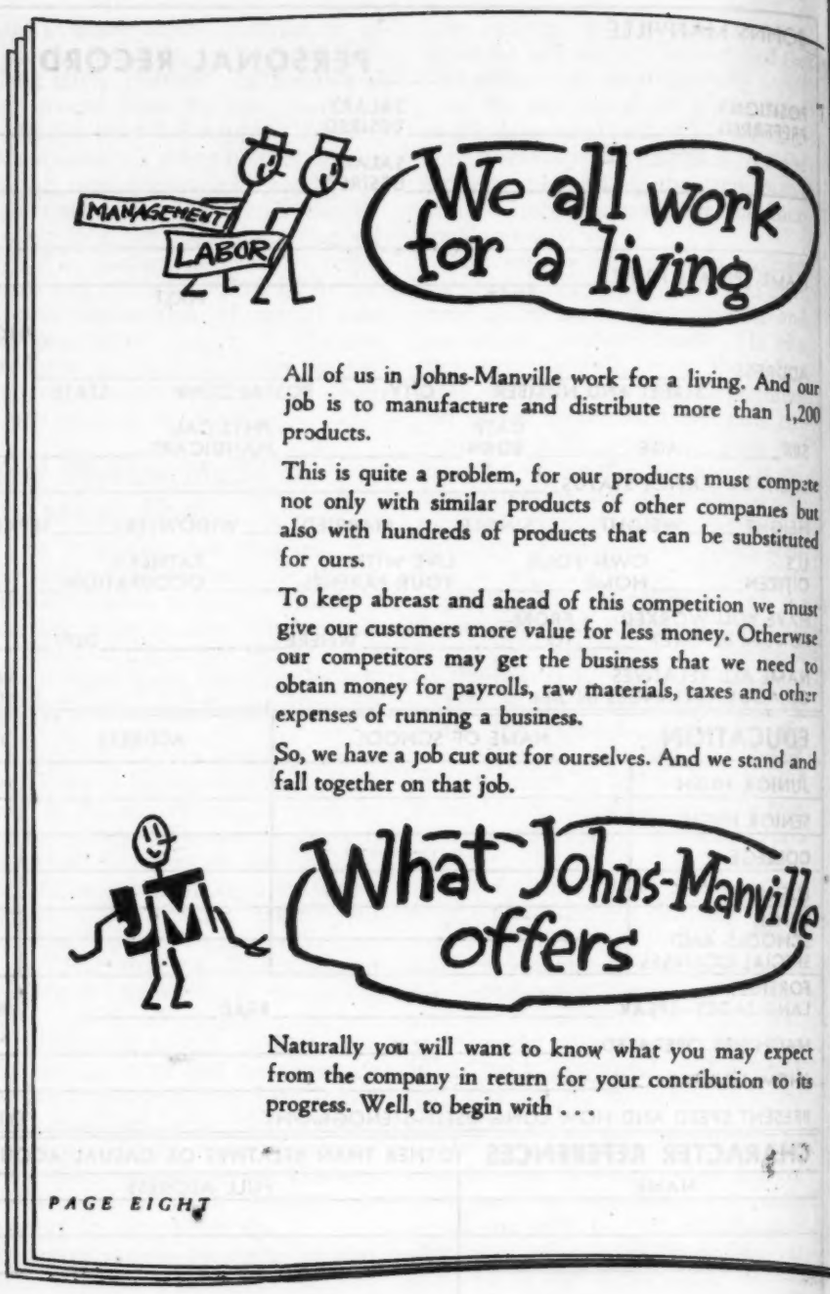
Opportunity Provided to Tell His Troubles

This follow-up interview provides an opportunity for the employee to get problems off his chest and gives the company a chance to correct misunderstandings and show its interest in the new jobholder, not as just a small cog in the machine, but as an individual.

He is again invited to take part in social and athletic activities. The scope of these activities varies among JM production locations. Many have "J-M Clubs," owned and operated by the employees, which are the center of most plant social activities.

In the first two weeks of a new employee's presence in a Johns-Manville factory the emphasis has been on the proper orientation of the man and the necessity for making him feel that his job is carried on in congenial surroundings, under supervisors who are personally interested in his progress and in his attitude.

The production efficiency of a man is directly proportional to his attitude. If his mind is free, if he is treated as an individual in all his dealings with the company, his state of mind and his sense of personal dignity will be such that his efficiency as a workman can be raised, by subsequent training, to a high degree. Quite naturally the response to this kind of treatment and this attitude depends greatly on the capabilities of the individual.


MANAGEMENT
LABOR
We all work for a living
All of us in Johns-Manville work for a living. And our job is to manufacture and distribute more than 1,200 products.
This is quite a problem, for our products must compete not only with similar products of other companies but also with hundreds of products that can be substituted for ours.
To keep abreast and ahead of this competition we must give our customers more value for less money. Otherwise our competitors may get the business that we need to obtain money for payrolls, raw materials, taxes and other expenses of running a business.
So, we have a job cut out for ourselves. And we stand and fall together on that job.
JM
What Johns-Manville offers
Naturally you will want to know what you may expect from the company in return for your contribution to its progress. Well, to begin with . . .
PAGE EIGHT

The rules governing and the methods of promotion and upgrading are a part of the over-all policy of Johns-Manville. The whole program was formulated after long and careful study in which jobs at all levels were analyzed.

During the first period the new employee is under the careful scrutiny of his foreman and superintendent with reference to his aptitude, performance, and personal record. The facts concerning him are carefully recorded. It is from these records, and from the reports of the foreman and superintendent, that the man's eligibility for further shop training is determined.

His qualifications for leadership are of special importance. If he shows these qualifications, he may be given training to fit him for a supervisory position.

The training programs in the JM factories are varied. Carefully prepared courses cover all levels of supervision. They are scheduled and usually conducted by the training section of the industrial relations department. Each factory has an individual who is responsible for training.

In consultation with the head of the local factory industrial relations department and the superintendent of the department in which he works, the new employee's eligibility for future training is determined. The selection is based on his personal inventory, the personal data obtained from his employment application

IT IS OUR POLICY TO:

Give all applicants a fair and equal chance to qualify as employees.

Give all employees equal opportunities for advancement.

Maintain reasonable hours of work.

Make every effort to provide steady employment

Provide safe and healthful working conditions.

Encourage friendly and cooperative relations among all groups within the company.

Guarantee all employees the right to confer with management individually or collectively on matters concerning their own or the company's interests

The company also contributes to insurance funds and to a retirement fund to provide greater security for employees and their families.

Now let's take up these items in more detail.

Getting a job with Johns-Manville

NO DISCRIMINATION—Johns-Manville does not discriminate against any one because of race, religion, political belief, or membership in any lawful organization. Preference, of course, is given to American citizens when selecting applicants for employment in the United States. And alien employees already with the company are encouraged and assisted to become American citizens.

Two pages from "Things You Need to Know About Your Job," the booklet that is given to all new employees in the Johns-Manville plants and mines. Among the subjects covered are the "Creed of Management," the company's history, pay, working hours, safety and health rules

form, his merit rating in the performance of his present job, and, if these are acceptable, on aptitude tests. Johns-Manville's training programs are long-term propositions and are planned in progressive stages so that training is available even up to the highest grades of plant management.

At no time during his progress through the various jobs is a worker free from the influence of the company's safety program. Each manufacturing department has a safety committee. Its members are recruited from the men working in the department and membership is rotated at stated intervals, so that every man, sooner or later, occupies a post on it. Every month there is a departmental safety meeting. It lasts only 10 minutes, but every person in every shift attends and listens to the foreman discuss some phase of the never-ending effort to make JM plants and mines safer places in which to work. The interplant and interdepartment safety competitions have proved a successful stimulus to the program.

There are several other phases of the JM industrial relations program that strive toward keeping the employee satisfied in his job and content with his surroundings.

One is the effort to see that employees are kept well informed concerning plant policies and practices. The "grapevine" has never been a satisfactory means of disseminating information. The distortion of facts that take place when information is passed by such means causes all manner of trouble. To eradicate this condition every phase of the training program devotes some portion of its time to keeping supervisors up to date on company policies, production problems, and the like. Regular information channels to foremen are established so that the foreman, as the member of the management at his level, will be regarded as the first and most trustworthy source of such information.

Reasons for Quitting Carefully Checked

Particular attention is paid to the men and women who voluntarily leave Johns-Manville. When an employee announces his intention to quit, his final pay check is sent to the industrial relations department, and the same man who interviewed him at his induction conducts the exit interview. The object of this final interview is not only to persuade the man to remain with the company—it is also to find out why he is leaving. Sometimes the employee will have little or nothing to say about his reasons for quitting. In many instances, however, it is possible to ascertain what has been wrong, and what is really behind his decision to leave.

This is profitable information and has, in some instances, enabled the company to improve or correct conditions or situations, often by training. Periodical summarizations of these exit interviews are made by the industrial relations department and placed before the factory manager for his information and action.

These reports are often of value in the human relations aspect of the training program. This particular portion of the program is applicable to all levels of management, from the manager to the foreman. It is regarded of great importance that the human element never be overlooked by the supervisors. It seeks to reveal the benefits derived from meeting and treating every employee as an individual.

TO INSURE LOW-COST PRODUCTION

2 Train to Do

Case of Caterpillar Tractor Company

W. M. OWEN
Assistant Director of Training
Caterpillar Tractor Company
Peoria, Ill.

TRAINING EMPLOYEES for job requirements at Caterpillar Tractor Company, Peoria, Ill., involves an educational program of unusual breadth. In addition, the program is noteworthy because it has proved so quickly adaptable to the inevitable train of changing conditions. It also has proved economical and gratifyingly successful in its main objective—*to train men how to do their jobs well.*

Types of Training

There are seven main branches of this well-integrated program:

1. **Apprentice training** — 4-year courses for apprentice machinists, pattern makers, and foundrymen.

2. **Orientation training**—a 2-year course for new employees fresh from college graduation.

3. **Machine shop training**—a 2-year course for developing expert operators of production machine tools.

4. **Welding training**—a 14-month course to develop skilled welders.

5. **Business training**—a 3-year on-the-job study of general office and production procedures.

6. **Cooperative training**—a 5-year course alternating between work in the plant and study in an engineering college for a college degree; also, 1-year courses alternating at half-day intervals between work in the plant and study for high school credit.

7. **Miscellaneous**—a varying number of short courses dealing with a wide diversity of subjects, including many for special job requirements, and a goodly number for general educational improvement.

For obvious reasons the greatest number of trainees at Caterpillar have been those who have taken the miscellaneous short-term courses. Not including the numbers who have taken these courses, more than 1500 persons have been graduated from this company's long-term training courses. Most of these are still employees or are on military leave.

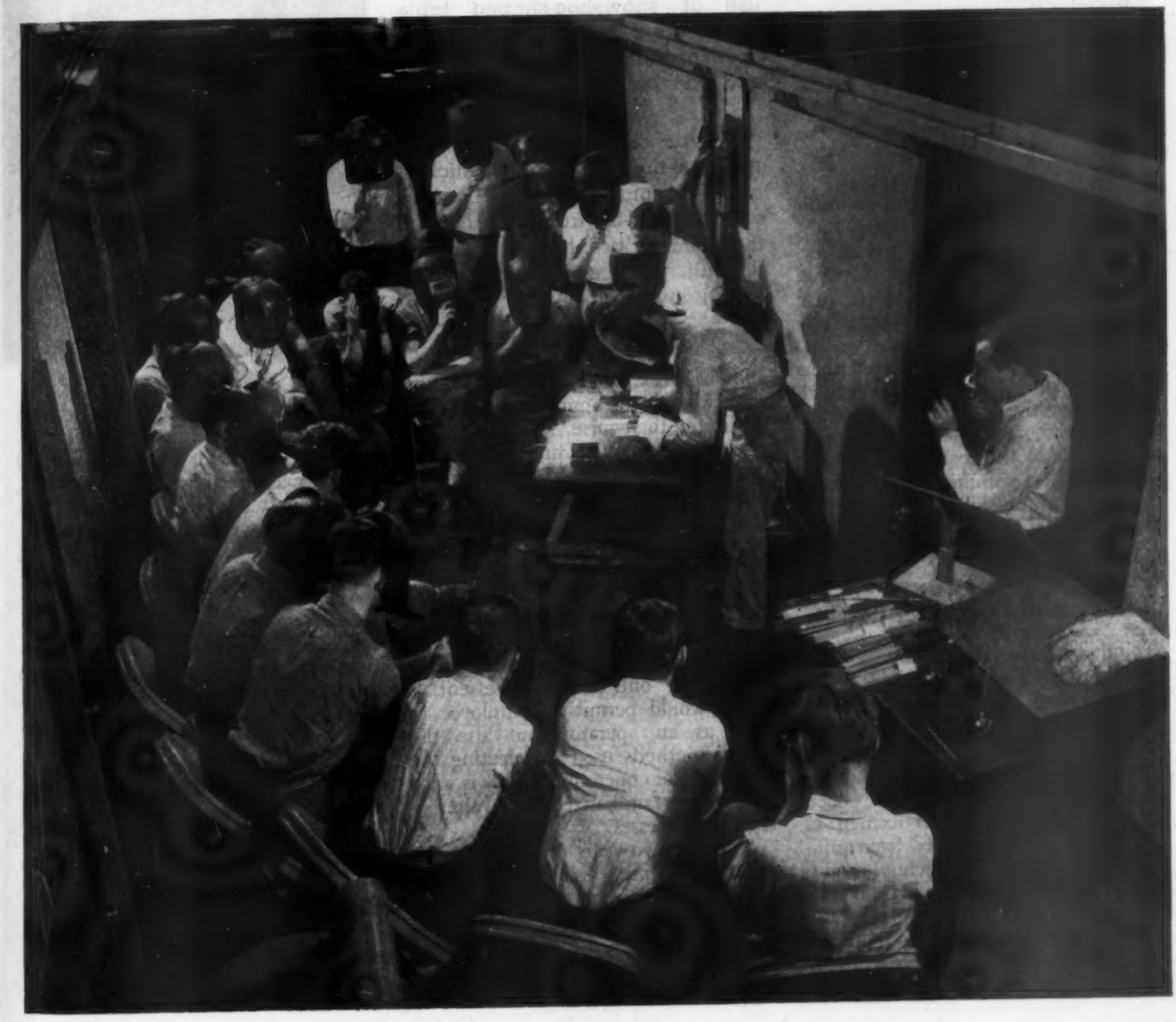
For classroom work the training department has four well-lighted, air-conditioned rooms, equipped with libraries of technical books, motion picture and other visual aid equipment, and laboratory apparatus. Personnel of the department consists of a director, two assistant directors, six supervisors, and fourteen instructors.

All of the main branches of the training program were developed to meet specific needs. Generally, new courses are added at the suggestion of foremen, supervisors, or members of top management, the training department designing and conducting the courses. For example, the chief inspector recently found that there had been a change of routine affecting a certain number of inspectors which required them to inspect subassemblies containing some welded connections, so he asked the training department to devise a short course in welding for

College Graduates

Theory behind two-year course for college graduates is that formaltraining makes them worth far more to the company than if everything were left to chance and individual initiative. The training schedule consists chiefly of working in different sections of the engineering and production departments, attending lectures and conferences, and preparing special reports based on assigned studies and investigations. Here, a demonstration of the performance of welding electrodes

Employees the Job



these men. Within a few days the training department had the course designed and in operation.

All courses and lesson material are designed in the training department. Within the department are staff members with experience in many of the trades and techniques used in this plant, and who additionally have been trained in imparting knowledge to others. If no one in the department is sufficiently familiar with the subject to be dealt with, some staff member is assigned to make a complete investigation. In such cases men in other departments who know the subject well furnish the factual matter needed by the training staff. When necessary, however, a staff member is sent out to other plants to seek the required information—as was done, for example, when it was decided recently to design a course in the fundamentals of hydraulic controls for machine tools. In this case, two staff members visited several manufacturers of controls until they had all the additional information needed.

Before put into use, every course is outlined as a whole, and also lesson by lesson. Consultations of departmental members are held to make each lesson as effective as possible before it is first used. Then, after its first use, each lesson is made the subject of a departmental clinic.

In addition to showing up possible improvements in the lessons, these clinics also serve to make the instructors more expert. At frequent intervals, meetings of the instructors are held at which one member is assigned to demonstrate some classroom or shop instruction method. Other members take the place of trainees and realistically oblige the demonstrator to put forth his best efforts. Strong points and defects in the technique are thus shown up and commented upon, and the pedagogical skills of all present are improved by participation and observation.

Machinist Apprentices

Under normal circumstances, only high school graduates with evidence of mechanical aptitude, and who are from 16 to 18 years of age, are eligible for any of the Caterpillar apprentice courses. For an indefinite period, however, these requirements have been changed to include ex-servicemen as well as young men rejected from military duty, who are high school graduates and whose ages are between 18 and 25 years.

Training of machinist apprentices, for example, is scheduled as a 4-year course (8320 hours), based upon a 40-hour week. Periods in which the work week is 48 hours tend, however, to shorten the course.

Upon acceptance, the youth or his parent or guardian signs an apprenticeship agreement which outlines the general terms. Then, as soon as an opening occurs, a selected applicant is notified and the training begins.

During the first two years, the training is devoted almost entirely to production work. In operating the various types of machines, the apprentice is shown not only the bare essentials which would permit an employee to serve as an operator, but also the proper methods used in selecting the sequence of operation. He is also thoroughly familiarized with alternatives in processes.

The last two years of machinist apprentice training incorporate more highly skilled jobs and operations such as work in the toolroom, tool design, and production planning departments.

Here is the sequence of training: Training shop, 4 weeks; drills, 8 weeks; milling, 8 weeks; assembly, 8 weeks; screw machine, 6 weeks; inspection, 8 weeks; engine lathe, 10 weeks; cylindrical grinder, 12 weeks; tool or cutter-grinder, 10 weeks; turret lathe, 30 weeks; shaper, (toolroom), 6 weeks; engine lathe (toolroom), 16 weeks; milling (toolroom), 16 weeks; machine repair, 12 weeks; bench, 16 weeks.

Tool design takes 26 weeks. Methods and application of good design are taught, and apprentices learn how to make drawings that are complete and easily interpreted by tool builders. The importance of incorporating attributes of safety, simplicity, efficiency, and ease of operation in designing tools is demonstrated.

Production planning, which takes up 16 weeks, provides opportunity to study the problems of maintaining an even flow of materials.

All through the four years apprentices attend classes three hours each week as part of their regular work.

Classroom Standards

1. Quiet. Classrooms or conference rooms sufficiently soundproofed so that the instructor can be heard without having to strain his voice.

2. Comfortable chairs. Luxury isn't needed, but benches and folding "funeral chairs" are unsuitable. If the learner becomes uncomfortable, his attention is diverted and money saved in furniture is wasted in poor learning.

3. Good visibility. This means adequate illumination. It also means proper seating arrangements. Instructors always have a slightly raised demonstration table. For conference-type meetings Caterpillar makes excellent use of snowshoe-shaped table that seats about 20 persons. The speaker stands at the broad end, and can be seen by all present.

4. Air conditioning. A stuffy room in the winter or a "sticky" room in summer is equally bad environment for training. Usually the summer problem is the more difficult. Air conditioning is the only known full cure.

Subjects studied under the guidance of instructors from the training department include: Blueprint reading and shop practices, job introduction, mathematics, effective reporting, manufacturing processes, industrial physics, engineering drawing, applied trigonometry, gearing and indexing, use of Machinery Handbook, heat-treatment and metallurgy, production planning, tool design, economics and industrial organization, compound angles, and hydraulics as applied to machine tools.

Pattern Makers

The training of pattern maker apprentices is fully as complete as that for machinists.

Trainees receive instruction both in wood and metal pattern making, and the program is based upon individual instruction both in classroom and in the shop. Apprentices spend two 90-minute periods each week in class.

Shop experience includes tractor machine shop, coremaking bench, small core assembly, loose pattern molding, elementary metal working, engine lathe practice, milling machine, casting layout inspection, elementary wood pattern making, advanced shop training.

At the beginning of the advanced stage, apprentices are divided into separate groups for wood or metal specialization. To provide training in metal pattern making equivalent to the previous course in wood, apprentices assigned to the metal division are given a supplementary 3-month period in metal pattern layout work and two months of drafting in the pattern shop office.

Foundry Apprentices

In this course the apprentice is given training and gets some experience in all of the major divisions of the foundry and closely associated departments. The shop schedule includes all types of coremaking; machine, bench, and floor molding; melting, pouring, cleaning, and inspection. To augment the training, added emphasis is given to work in the metallurgical laboratory. The schedule covers also assignments in both the wood and metal pattern shops.

Classroom work, in addition to general subjects, covers foundry technology including foundry materials, molding, coremaking, melting practice, and cupola charge calculations; gating practice, cast-iron metallurgy, and elementary pattern construction.

Machine Operators

The 2-year machine shop training course was designed to provide training on the various types of production machines. Any employee who has sufficiently demonstrated a capacity and desire to gain proficiency in the machinist trade, and who is between

Musts for Instructors in Caterpillar

1. Speak clearly and loudly enough. Look from one face to another. Stand reasonably still and avoid distractions such as whirling a watch-chain. Speak from notes but do not read whole lessons from text. Use simple language and avoid abstract statements. Use specific examples to explain difficult points.

2. Show a real interest in students as individuals. Encourage them to ask questions if they are unclear about any point. Never by implication or statement indicate that a student is stupid or slow. If one student shows he has missed a point, ask how many others have missed it also. This will show whether repetition is needed for the whole class or for only one or a few.

3. Be an opportunist. Although the prescribed points of a course follow a definite sequence, there may be more good than harm if an unnecessary point is sandwiched in—especially if a student suggests it. Such suggestions indicate interest and encouragement of interest will stimulate learning of the main subject as well as of the secondary matter.

4. Maintain order. One of the commonest classroom difficulties consists of talking at a time when only the instructor or one trainee has the floor. In such case, stop the whole proceedings and remind everyone that it is necessary to be thoughtful of others, asking an end of the unprivileged conversations. Always base such comments on the convenience and service to the class as a whole and not obedience to some rule or service to the instructor.

5. Repeat questions. When a trainee asks a question, repeat it to make sure that all the class has heard. As many trainees will originally state the question in a low voice, it is better to repeat it than to ask the trainee to stand up, face the class, and use a loud voice. Avoid anything that will embarrass a student or discourage the whole class from taking an active part in the desired discussions.

6. Reply to the entire group. A common mistake is to answer one man's question directly to him, rather than to the class, and in a voice too low for the whole class to hear. To avoid losing the whole group's interest, aim both the question and the answer toward the back row, and by practice or test make sure the voice is loud enough for those in the back row to hear.

7. Explain why the subject of the discussion is important. The time for this is at the very beginning of every new course, and to a lesser extent the same idea is applicable at the corresponding start of every new lesson. Show the practical value of the knowledge you wish to impart and you will win more mental effort from the students, especially in an otherwise "dry" subject. For example, an instructor in trigonometry shows his classes how this subject is used to position five equidistant holes around the perimeter of a circle, and points

Caterpillar training instructors are experts in presenting the subject in an interesting way and holding the attention of trainees

the ages of 20 and 35, is eligible for this course.

The shopwork in this course includes training on the following production stations: Tool grinder, 8 weeks; drilling machines, 12 weeks; milling machines, 20 weeks; turret lathes, 20 weeks; automatic lathes, 12 weeks; grinding machines, 8 weeks; and an 18-week period of directional training which includes inspection, advanced tool grinding, heat-treat, or special machine operation.

Approximately 266 hours of classroom work are scheduled, usually in 2-hour sessions. Subjects include blueprint reading, 20 hours; mathematics, 20 hours; economics, 20 hours; job planning, 20 hours; manufacturing processes, 40 hours; shop fundamentals, 20 hours; shop trigonometry, 20 hours; and shop physics and heat-treat, 20 hours.

Training Courses

out that problems of this nature are both practical and frequently recurring. Be specific in explaining the importance of a subject. Tell the class where the problem is encountered and who encounters it.

8. Start teaching the subject at a comparatively low level. It may not appear necessary, considering the intelligence of the class, but there are always some members who are not as well prepared in advance as others. Don't underrate importance of adequate preliminaries.

9. Use visual aids. Whenever possible, show motion pictures, strip-slide films, or other visual aids to familiarize the class with the subject matter, its importance, and how it operates. Don't try to describe solely with words what an object looks like or how it works when you can show the object itself or a picture of it. Use jumbo-sized models of small-sized parts or tools to explain how they work. Have a large blackboard handy for making rough illustrations during lectures, or for mathematical demonstrations or similar purposes.

10. Use a guide or outline. Don't put the cart before the horse in teaching. Some variations in the sequence of subject matter are proper, but there is a general sequence that should be followed if the class is to be taught as expeditiously as possible. Don't start talking about point 12 before you have explained point 8, if—as is probable—it contains an essential key to the understanding of 12. Keep a record on the guide of how far each class has progressed.

11. Limit the time. Never exceed two hours of continuous instruction. The average person cannot concentrate any longer than this. If possible, use a motion picture or some similar device to change the pace of instruction in any class that lasts for more than an hour. Don't keep the class sitting down too long, either. Let them have a "seventh inning stretch" occasionally, especially if the subject being dealt with is calling for heavy mental effort. Try to arrange courses so that the heaviest thinking will be done during hours when the class is mentally and physically fresh.

Arc Welders

Originally this course included sheet-metal and arc welding and was on a 2-year schedule, but now it has been cut to a 14-month limit and includes only arc welding. Eligibility standards are of the same type as those for the machine shop course.

The shop schedule is arranged to give the participant complete training in arc welding, including welding in all positions. Intensive individual instruction on the characteristics of various rods and equipment precede job assignment to production welding stations. Experience is gained in both light- and heavy-gage work, and in a variety of work, most of which is manually welded. This course also includes experience with the use of welding fixtures. Related classroom work includes the study of blueprint reading, mathematics, elements of electricity, welding machines, welding metallurgy, testing and inspection of welds.

Business Training

One of the newest enterprises of the training department is a course in business practices to train qualified young men in general office procedures. This is a 3-year course of actual participation in the work of various departments, accompanied by classroom instruction.

Departmental work includes: Manufacturing department—timekeeping, planning, materials control; accounting department—manufacturing costs, tabulation, auditing; traffic department—orders and traffic; treasury department—receipts and expenditures, statement analysis; purchasing department—commodity records, posting, checking, procurements; parts department—order, tabulation, invoicing, stock control, order filling, shipping.

Classroom instruction is given three hours each week, dealing with elementary corporation accounting and auditing, industrial cost accounting, elementary business law, business administration, industrial organization and management, and the general relationships of business enterprise to modern society. Other phases of the instruction include the reading of blueprints, operation of office machines, and a non-technical study of the principles of the company's products.

Candidates for admittance to this course are usually required to be high school graduates from 16 to 18 years of age. Selections are made on the basis of high school records, entrance test grades, personal interest, and alertness.

College Graduates

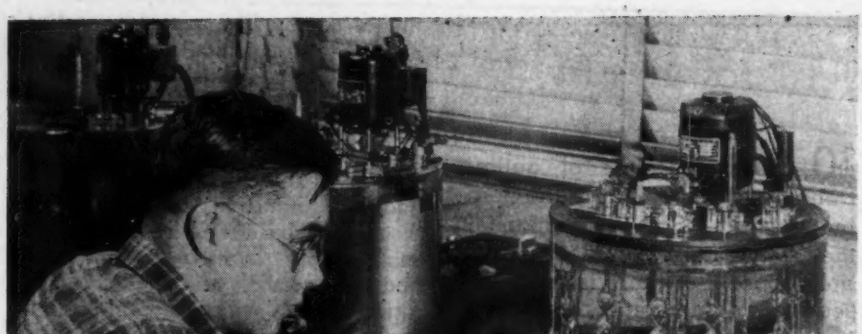
The theory behind Caterpillar's 2-year course for college graduates is that by thoroughly acquainting these men with all phases of the company's activities, a greater practical value can be added to their previous education than would be possible if their experience in the company were left entirely to chance and individual initiative. Second, even the basic orientation required in the change-over from academic to industrial life is accomplished more quickly as well as more thoroughly.

In 1931 a training course for engineering graduates was started for the purpose of supplying the needs of the engineering department for technically trained men with practical experience. Later it was found that graduates with practical experience in the engineering and production phases of the company activities were well equipped to assume responsibilities in other departments. This form of training was therefore expanded until today graduates both in engineering and in other fields are selected to take this course.

To qualify for it, the applicant must be a graduate of an accredited college and have shown superior scholastic ability. Extra-curricular activities are given consideration, as also are such matters as the amount of college expenses the student himself earned.

A special departmental meeting is held annually to decide the number of graduates to be employed for this training, and the type of undergraduate training desired. The training department then undertakes to interview and hire graduates.

The training schedule consists



chiefly of working in different divisions of the manufacturing and engineering departments, attending technical lectures and conferences, and preparing special reports based on assigned studies and investigations.

First period of training, called basic, usually gives the employee 7 weeks in the track-type tractor assembly test department, 4 weeks in motor grader assembly, 4 weeks in wheel-type tractor assembly, 7 weeks in diesel engine assembly and test, 8 weeks in the research laboratory, 4 weeks at the proving grounds, 4 weeks in the engineering office, 4 weeks in the heat-treat department, and 8 weeks in field service.

The schedule of work in the assembly departments is designed to give the graduate an opportunity to become familiar with the mechanical details of Caterpillar products. It is felt that nothing in the way of formal instruction can take the place of actually engaging in such work. Not only does this develop product familiarity and a degree of dexterity in the work, it also stimulates appreciation of good design and workmanship, gives the men experience in dealing with fellow-workmen, and in general develops self-reliance and resourcefulness.

At the conclusion of the first year of training, folders are prepared containing all pertinent data regarding the trainee and his progress in the training course. These folders are made available to all departments employing college graduates, which leads to interviews with interested department heads concerning a tentative selection of work to be undertaken by the trainee at the conclusion of his course.

After the tentative selection of work has been made, the training department prepares a directional training program for each trainee. This is done in consultation with the head of the department that expects eventually to make use of the graduate's services.

The second year usually includes assignment to four or five different departments. Meantime, weekly meetings of the engineering training group are held on company time. Every other week special lectures by departmental executives are arranged for these meetings to acquaint trainees with company organization and practices, and to provide technical information which is not usually obtained in shop or laboratory. In alternate weeks the program consists of the reading and discussion of reports prepared by the trainees on assigned studies and investigations.

College Co-ops

A 5-year cooperative training course, in which employees alternately work four months in the shop or laboratory and attend college classes four months at Illinois Institute of Technology, leads to a bachelor's degree from the college and an apprenticeship graduation diploma from the company.

This plan of training has been available at Caterpillar since 1938. It is open to any member of the 4-year apprentice training courses who has completed approximately a year of his apprenticeship. He is required also to meet the entrance standards of the Institute, including high school credits in physics, chemistry, advanced algebra, and solid geometry.

Apprentices who participate in the 5-year program go to school each alternate 4-month period for special courses in mechanical engineering. Wages are paid the employees only in the 4-month period while they are working at Caterpillar. Tuition and expenses at the college are paid by the students.

Subjects studied are those usually included in the curriculums of regular 4-year college courses. Shopwork done by the trainee follows about the same pattern as that given to 4-year apprentices, but includes work in all manufacturing departments. The time spent on each job or machine is somewhat shorter in the 5-year program.

High School Co-ops

Cooperative training program enables young men to get plant experience while continuing classroom work for a high school diploma. High school co-ops attend morning or afternoon classes at their regular schools and spend the alternate half-days in the Caterpillar plant. Work assignments are confined to the foundry and tractor laboratories, the research physical and chemical laboratory, and the tracing section of the engineering department. Boys serve as helpers, so learn by doing

High School Co-ops

A technique basically like that of the 5-year course leading to a college degree is also in use to enable young men to get plant experience while continuing classroom work for a high school diploma.

Starting in the fall of 1944, four students were accepted from the senior classes of each of four Peoria high schools. Thereafter they attend morning or afternoon classes at their regular schools and spend the alternate half-days in the Caterpillar plant. Plant work is fixed at four hours a day, five days a week, with a maximum of five hours on Saturday. Saturday's schedule includes two hours of classroom work conducted by the training department.

The combined work and study in the plant in one school-year's time gives the youth two full-year credits toward his high school diploma, but only one of these credits is acceptable for college entrance.

Work assignments are confined to the foundry and tractor metallurgical laboratories, the research physical and chemical laboratory, and, starting with the spring term in 1945, the tracing section of the engineering department. The boys serve as helpers, and thus learn by doing. A total of 22 boys have been enrolled.

Apprentices

Four-year courses for machinists, pattern makers, and foundrymen comprise the apprentice training program. The machinist apprentice shown with his instructor on an engine lathe gets 4 weeks of orientation in the training shop, spends 8 weeks on drills, 8 on milling machines, 8 on assembly work, 6 on screw machines, 8 on inspection, 10 on engine lathes, and so on all the way to 30 weeks on turret lathes, 12 weeks on machine repair, 26 in tool design, and 16 in production planning

In the tracing section, for example, tracing techniques are taught by demonstration on the job. The work consists chiefly of tracing detailed drawings, done in pencil by engineers, on tracing linen in ink.

When the students are new, each job is orally briefed by a section supervisor so that they will understand what they are doing. When inking technique has been mastered, the students are then assigned to copying drawings which have not been corrected to meet changes in specifications. This obliges the students to translate the written changes into drawings which differ from the originals. Within a few months the students are adept at such work, but all of their work is subject to rigorous inspection by the section supervisor.

All worker-students in the high school cooperative course are paid 50 cents an hour for the first 520 hours, 53 cents during the second 520 hours, and 56 cents an hour for the remainder of their participation in the program.

While classroom work at the beginning of the program is concentrated largely on expert instruction in the basic how-to-do details of the jobs to which the students have been specifically assigned, it also includes a study of other subjects.

First the student is made acquainted with the organization structure of the company, and with its history and products. Films are shown in the classroom to visualize the operating principles of gasoline and diesel engines. Other films show the operating principles of the track-type tractor and of allied equipment such as scrapers, bulldozers, power take-off, and tampers. Cut-away models are shown in motion by the classroom lecturer.

Also there are lectures, films, and slides, and classroom practice in three-view sketching, isometric sketching, blueprint reading. There are discussions and shop practice on drills, milling machines, engine and turret lathes. Caterpillar maintains a large room equipped with many types of machinery—mostly of the rehabilitated variety—especially for training purposes, not only for the high school cooperative students but also for use in other phases of the training program.

Specialized Courses

Biggest field of training activities in number of students is a series of concentrated, specialized, one-subject courses, some of which are exclusively for foremen and supervisors, while others are for regular employees seeking or scheduled for upgrading, or for a change to unfamiliar duties. In the group also are new employees who have been assigned to jobs of a type for which training of a few days to about two weeks is all that is justified or necessary.

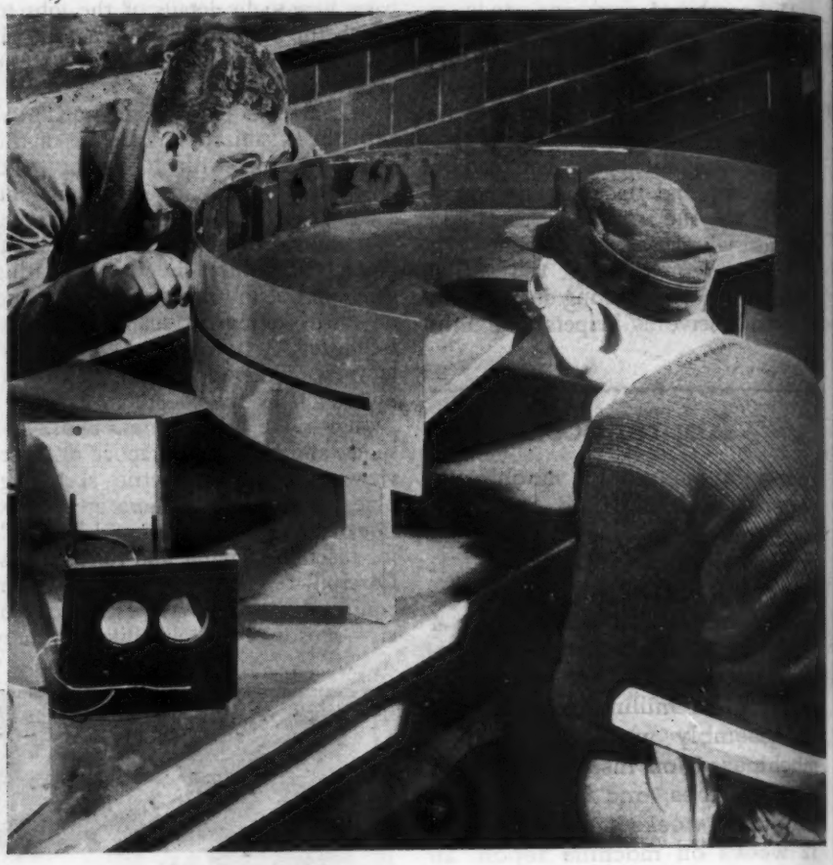
Typical of the latter is the training of truck and tractor operators. This was one of the jobs for which training long remained on an informal basis. If a man could drive an automobile,

Truck Operators

Quick training for truck and tractor drivers is typical of many concentrated, specialized courses that are developed as the need for them arises.

New drivers now get a physical examination which covers visual acuity, color recognition, steadiness, and reaction time. Ten hours of classroom work stresses safety, responsibilities of the job, etc.; familiarizes the trainee with the section of the plant to which he or she is to be assigned.

Most of the rest of the time is spent in actual driving practice, beginning with starts and stops and turns the first day—all inside a safely barricaded area—to actual driving on the third day within the area where the driver is to work . . . If the trainee completes the course satisfactorily, he or she is given a driver's license by the safety department



it was presumed he was almost fully equipped to drive a truck or tractor in the rounds of the plant. To a casual eye it appeared that this theory was correct. Men did become drivers of plant vehicles with little more training than a few practice starts and stops, and a foreman's urge to use caution. Young men, especially, seemed adept at this job. To youth accustomed to hitting 70 miles on the highway, the relatively slow-moving tractors seemed almost too easy.

Then one day a member of the training department heard a maintenance department engineer mention that the yearly upkeep for some of the vehicles was running a good fraction of the original cost of about $3000.

An investigation was in order. It showed that much of the upkeep was caused by improper driving. Trucks were used as "pushers" which were not equipped for that purpose. Or, somebody would try to make a 1-ton truck do a 2-ton job, with consequent strain on the whole mechanism and especially the clutch, which naturally resulted in high repair costs.

Further investigation showed that in a great many instances it would be better to hire people who knew nothing about operating a truck, and teach them, than some of those who had seemed to know so much that teaching was unnecessary. Accordingly the training department provided a 2-day course for all drivers then on the payroll, and a 3-day course for all new ones hired.

Other Short Courses

While the full arc welding course is a 14-month job, the special welding training for inspectors is another one of the short-course projects. Similarly, there is a 4-week course to teach candidates for drafting. Dozens of other short courses in specific jobs or specific subjects are available. Some of the specific subjects are required study for people who are candidates for promotion. Many, however, are taken voluntarily by employees who seek upgrading. Typical of these subjects are blueprint reading and several varieties of mathematics.

Other short courses also have been used during the war as emergency methods of putting untrained personnel into semi-skilled or skilled jobs. They include machine tool operation, arc welding, engineering physics, tool drafting and detailing, heat-treat and metallurgical laboratory techniques, welding qualification testing, research laboratory work, and punch press operation. In 1944 alone, 1575 men and women participated in fifteen war training programs of this type.

Supervisor Training

A wide range of short courses is available as electives for supervisors. In this category the practice of the training department is to prepare an extensive list of suggested subjects, and then poll the foremen. Over a period of years, courses are continued until there is no longer need for them.

Current training for supervisors, on an elective basis, includes job instructor training, job methods training, job relations training, supervisor routine, products at work, effective speech, legislation affecting supervisors, and economics of industry. Other subjects recently offered include conference leading, personality traits, and better English. Past subjects include foundry practices, machine shop practice, welding, accident control, quality control, time study, heat-treatment.

Most of the subjects are covered in 8 to 10 hours, broken into a series of 1½- to 2-hour meetings, held at weekly or semi-weekly intervals. About 80 percent of all foremen sign up for at least one course each year and some take as many as six during a year.

Training for Veterans

Naturally one of the biggest items on the future schedule of the training department is job instruction for re-

turning veterans. With more than 5500 employees now on leave to the armed forces, their eventual return calls for intelligent, large-scale planning by the company.

The department is ready. It will go out and meet the problem more than halfway. Already large numbers of the on-leave men in uniform have received booklets telling them of the steps the company has taken to make jobs available for them on their homecoming.

The training department has long experience in dealing with problems of veterans who are physically handicapped. In recent years more than 1000 physically handicapped workers have been trained and given jobs in this company.

In many cases, as soon as the war veteran's condition has been determined and a job assignment made for him, an instructor from the training department takes personal charge and devises special training techniques to fit the individual case.

For the average veteran, who has no physical handicap but whose skills may have become rusty, there are short courses of the same type that Caterpillar now uses for new production employees and for those who are being upgraded or who otherwise are changing jobs.

Most of these courses are already in operation, but some will be further accelerated. A returning truckdriver, for example, will take the 2-day instead of the 3-day course, in recognition of the fact that he has been familiar with the job in the past. However, even he will need to be trained in revisions that have been made in plant layout, and doubtless will benefit from the extra stress that will be placed upon safety. In other words, it will be the training department's duty to make sure that the veteran receives current information and will not try to make his fork-lift truck perform like a jeep.

In addition, there will be available to veterans who qualify, courses ranging from 14 months to 5 years, including production, business, welding training, apprentice training, and the college cooperative work-study training. Each of these training courses has been approved by the Veterans Administration and as such the veteran trainee or apprentice receives benefits under Public Law 16 and the G. I. Bill of Rights.

Economic Discussions

In some courses, discussions of economics are almost inevitable. The rule at Caterpillar is: *Let the instructor be prepared.* For example, one supervisor—thinking about the future—popped up with the question, "How will the government get rid of surplus tractors?" The answer, therefore, led into a discussion of the Surplus Property Administration. By the time this was finished, the word "prosperity" had crept in. So, "What makes prosperity?" a young supervisor thoughtfully inquired. The answer to this question involved the matter of producers and consumers, how prices are established, and a number of other related topics.

One member of the training staff has found it especially helpful to prepare separate discussion outlines on a wide range of basic topics in this category. These go with him in a loose-leaf notebook to every class, so that at any time one of the subjects is unexpectedly opened he can turn to an outline and discuss the subject in an orderly and logical manner.

Under the subject of "Patents and Inventions," for example, this instructor has sixteen subtitles, accompanied by the essential facts, such as: *Have patents interfered with war production?* Key answer to this is: Since 1910 the U. S. government has had power to have anyone make anything for its use regardless of patents.

Also typical: *How does a patent right differ from other property rights?* Answer: It excludes others from making, using, and selling the patented invention without the inventor's permission . . . but only to a limit of 17 years. It does not deprive the public of something that the public had previously.

Future Adaptations

Keynote of Caterpillar's training program for the future will be adaptability or adjustability to whatever variations in situation may occur. This is also a prime characteristic of the program as it is today and as it has developed over the past years.

The training department, in general, will organize its courses to fit the needs of the company as men of various types of skills are needed. But it will also give much consideration to the miscellaneous educational desires of the employees themselves—not merely because it has something of an altruistic attitude, but because there is a firm conviction among top management that each new bit of training, of education, adds something to the value of the men. In other words, Caterpillar management is convinced that the total wisdom and skill of the company, and its efficiency, is simply the sum total of the wisdom and skill of all its men—those in the shops as well as those in the administrative offices.

TO INSURE LOW-COST PRODUCTION

3 Adopt

Case of Westinghouse Electric Corporation

J. H. SANSONETTI
Plant Layout Engineer

R. W. MALLICK
Section Engineer

Headquarters Manufacturing Engineering Department
Westinghouse Electric Corporation
East Pittsburgh

GOOD PLANT LAYOUT, as defined at Westinghouse Electric Corporation, means (a) placing the right equipment, (b) coupled with the right method, (c) in the right place, (d) to permit the processing of a product unit in the most effective manner, (e) through the shortest possible distance, and (f) in the shortest possible time. The importance of good layout as a factor in insuring low-cost production is thus well established, and its need is well understood.

Operating, as Westinghouse does, some 30 plants and divisions and 34 manufacturing and repair plants throughout the United States, it is indeed confronted with a diversity of operations that call for the newest and best in layout methods. The size of the problem can perhaps be visualized when it is noted that plant facilities range from small plants and repair shops employing a few hundred people to manufacturing divisions with more than 10,000 workers.

Ten-Point Approach to Layout Problems

Out of this wide experience, Westinghouse layout engineers have developed a 10-point general approach which they have found helpful when preparing new layouts:

1. Determine your objective before you start a new project.

2. Be sure you know what, how many, when—so far as your production is concerned.

3. Make a thorough manufacturing analysis; get data on quality requirements and other auxiliary operations.

4. Work from time values established by authoritative personnel.

5. Don't fail to make flow charts if nature of problem requires them.

6. Make a thorough check of existing conditions and equipment where these are involved in the new layout. Check every detail; it saves time and money later.

7. Remember that your layout drawing is a design specification just like the design of a product. Be sure, therefore, that the drawing and the details are prepared with the same degree of accuracy.

8. Remember that the people who review your layout do not always have the same mental picture that you have. Make your presentation in such a manner that everyone discussing the layout visualizes it in the same way.

9. Keep in mind the human side of the picture when designing your layout. Remember that industrial plants are literally communities.

10. Remember always that handling adds only to the cost, and nothing to the value, of the product.

To accomplish its plant layout engineering functions, Westinghouse maintains a headquarters plant layout and materials handling section, which serves as an advisory staff. Most principal divisions also maintain a local plant layout department. Where the operation is too small to justify a local organization, the headquarters manufacturing engineering department provides the necessary service.

All Layout Projects Coordinated

The headquarters staff issues and maintains a plant planning and layout manual and a materials handling manual, and, in general, develops information and procedures to assist local

the Best in Layout

divisional personnel to carry on their work. It also trains personnel for transfer to divisional staffs. By this type of organization, the operations throughout the company can be more effectively cooordinated, and records and information easily interchanged. Peak loads at various locations can be easily handled through the assistance of the headquarters staff or by the temporary interchange of personnel between divisions.

The approach to any new layout, whether it involves the rearrangement of a small group or plant, or the set-up of an entirely new plant, is the same. For the purpose of observing how the system works, assume that a request for a major layout has been made, and that it involves the services of the headquarters plant layout staff.

If the request is made verbally, it is later verified and then entered on a standard form used for this purpose by the headquarters staff. When the request is received, either the department head or his assistant at once gets

Three-dimensional layout of a high-production line. Use of scale models insures best arrangement of machines and equipment, permits more accurate analysis of the problem, eliminates most of the least obvious "bugs" before a move is made toward installation

COMPONENT PART ANALYSIS

COMPILED BY

DATE

Apparatus	Size of Type	Part Name	Drawing and Item	Size	Weight	Monthly Activity

MACHINE LOAD DATA

COMPILED BY

DATE

DESCRIPTION OF MACHINE AND SIZE

Apparatus	Part and Drawing	Operation	Time		Monthly Activity	Set-Ups per Month
			Set-Up	Each Piece		

MANUFACTURING LAYOUT DATA

COMPILED BY

DATE

APPARATUS

APPARATUS OR PART TYPE STYLE O

SIZE WEIGHT ACTIVITY: MONTHLY

REMARKS

Part	Drawing or Style	Quantity Per Unit	Operation	Machine	Machine Number	Location

in touch with the people who initiated the request and endeavors to find out the full scope of the work to be done. The project is then thoroughly analyzed by manufacturing engineers and assigned to a certain plant layout engineer.

Existing Facilities Checked First

From this point on, the plant layout engineer, with the assistance of any other department personnel he may require, follows a very definite procedure. He begins at once to assemble all information available concerning the project and takes the necessary steps to collect any data that may be missing. His first step is to check all existing records, and, if the project involves the use of existing facilities, they too are checked to make sure they can be used in the new layout.

If detailed plans of the building structure are not available, it is necessary to make measured drawings of these buildings with all existing services shown. These drawings are made at the scale of ¼ inch to the foot and cover all floor plan conditions only, with no machine tools or other accessories shown. These floor plans, along with any required sections through the building, are drawn in ink on cloth and become a permanent record of the building apart from any drawings made of the layout.

The next step is to make a complete record of all existing machine tools, auxiliary equipment, and handling facilities available. This sketch is drawn up also at the scale of ¼ inch to the foot, and records all equipment and facilities as they exist prior to any changes that may be made. It also enables the engineer to analyze existing material flow and helps him determine where improvements are to be made. When the new layout is completed, comparisons between the old layout and the new layout can be easily shown. The importance of the accuracy of this record cannot be stressed too highly, since the success of the new layout depends a great deal on the completeness of the data shown on the existing drawings.

All plan drafting work is done on

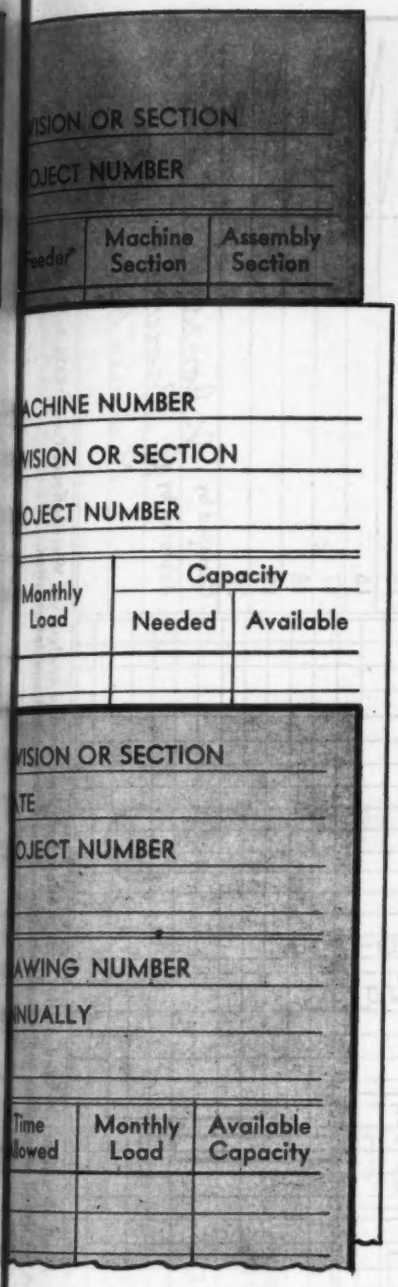


Figure 1. Analysis forms used by the layout engineer to gather field information include component part analysis, machine load data, and manufacturing layout data sheets. Not shown is the machine tool layout information sheet which supplies complete data regarding machine, motor, controls, etc., and includes both a plan view and a ¾-view photograph of the equipment

standard 24x36-in. sheets of tracing paper covering a predetermined building area as shown on a key plan of the building. This is done so that, when a change is a local one, only one sheet may be used, but when the change covers the entire plant a complete plan can be obtained by joining the necessary sheets at the matching lines.

Complete Production Data Compiled

Paralleling the gathering of the field information, the layout engineer compiles the production data concerning the product to be made which will be covered by the new layout. He consults with managers, design engineers, supervisors, manufacturing engineers, foremen, and other interested persons with a view to getting the answers to such questions as: What are the products? Are any design changes contemplated? What is the rate of the present production? What production is wanted? How long will the activity last? How much flexibility should the layout have?

To obtain these data, the layout engineer uses four forms: Machine tool layout information, manufacturing layout data, machine load data, component part analysis. Some layouts, because of their scope, require the use of all four, whereas only one or two may be needed to compile the field information needed on some of the simpler projects. Three of these forms are shown in Figure 1. The fourth (machine tool layout information) is not shown; it supplies full data regarding machine, motor, and controls, and includes a plan view sketch and ¾-view photograph.

Flow Charts Made of Existing Methods

All the above information is recorded for future reference in a data book which becomes a permanent record of the project. Along with the above studies the layout engineer begins to analyze the manufacturing operations and time study values, and make flow charts based on existing conditions. These charts are an important part of the work because they reveal the weak points in the present layout and point out rather clearly where improvements can be made.

While all this information is being compiled, draftsmen have been preparing scale drawings of the building floor plans showing all the existing equipment. These are used to make accurate templet drawings of the equipment and to study individual work station layouts (Figure 2) which are necessary before actual work can start on the new layout.

When making templet drawings of the production facilities required, one of two general plans is followed. If the time limit for the new layout is short, a blueprint is made of the existing layout, and all the machine tools and auxiliary equipment are cut out of this print. This method saves a considerable amount of time in drawing new templets but does not permit carrying out the standard color scheme used in layout work. When time permits, and a more finished appearing layout is desired, as well as a more permanent one, templets are drawn on, and cut out of, a fairly heavy bristolboard of the color desired for the various kinds of templets used. Colors used are: *Salmon*, machine tools; *green*, stationary equipment, benches, bins, and racks; *yellow*, conveyors; *red*, storage areas (equipment, materials). The advantage of using bristolboard can be readily appreciated when several layouts must be made and the same templets used each time.

At this time a review of the manufacturing layout and estimate sheet (not shown) and operation analysis form (Figure 3) provides the basic information for developing the flow of materials through the new layout. (The manufacturing layout and estimate sheet—actual size, 11x24 inches, contains complete data on identification of the product, time and cost estimate, machine tools recommended, and small tools and auxiliary equipment.) Then by taking a floor blank usually drawn to a small scale of the building in which the layout is to be housed, a preliminary area allocation of the areas required for the various activities is laid out.

On this rough plan of the areas involved (Figure 4), an effective geographic flow line of the product can be established. When the proper flow has been determined, this chart serves as a nucleus around which the trial templet layout (¼ inch = 1 foot) can be made. It must be remembered that this chart is merely intended to act as a guide and quick reference for the final layout, and does not show any of the details.

"Cut and Try" Procedure Often Necessary

While the science of plant layout follows certain definite laws just as any other science, much of the principal development of the actual layout of the equipment arrangement is a "cut and try" procedure. In any such development it must first be determined what fundamental principle of operation the layout is to follow. Then there must be an adequate determination of the space requirements for each of the activities necessary, re-

WORK STATION LAYOUT

WORK STATION LAYOUT FOR # 4034 TOLEDO PUNCH PRESS

Location—Section B 2 Column 17 Side WEST Cost Center 220 Division

Principal apparatus upon which work is performed BALLAST CASES Annual Activity 940,000

Type of operations performed at this work station PIERCE - BLANK - CUT OFF AND FORM

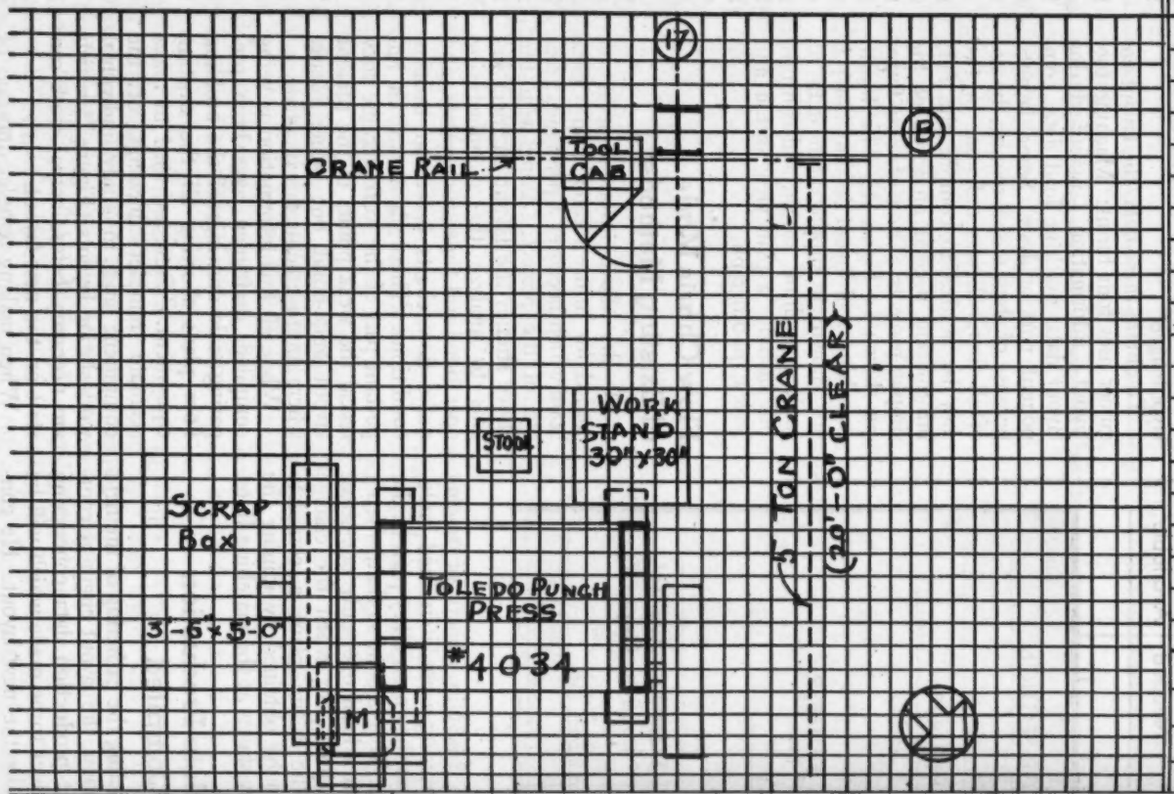
Number of Shifts worked 1 Operators 1 Male 0 Female per shift. Irregular operators 0

MATERIAL HANDLING: (A) Brought by: OVERHEAD CRANE (B) Removed by: ELECTRIC TRUCK

(C) Handled at work station by: OPERATOR USING STAND

LIST OF EQUIPMENT USED AT THIS STATION AS SHOWN

SKETCH



OPERATION	Allowed S.U. Time R.T.
1 PIERCE & BLANK LIDS	
2 PIERCE, NOTCH & FORM BOXES	
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Compiled by J. Jones Date 6-1-45

Approved by H. Brown Plant Layout Eng.

P. Smith Time Study Dept.

NOTE Use ¼" per foot scale when possible. Show in detail all equipment used at this work station. For reference and analysis use Westinghouse Form 18326-A, "Operation Analysis Record," to assure that your analysis is correct. Use form 21651-A for detail of machine tool equipment. Use reverse side for additional information.

Figure 2. Studies of individual stations are necessary before work can start on the new layout

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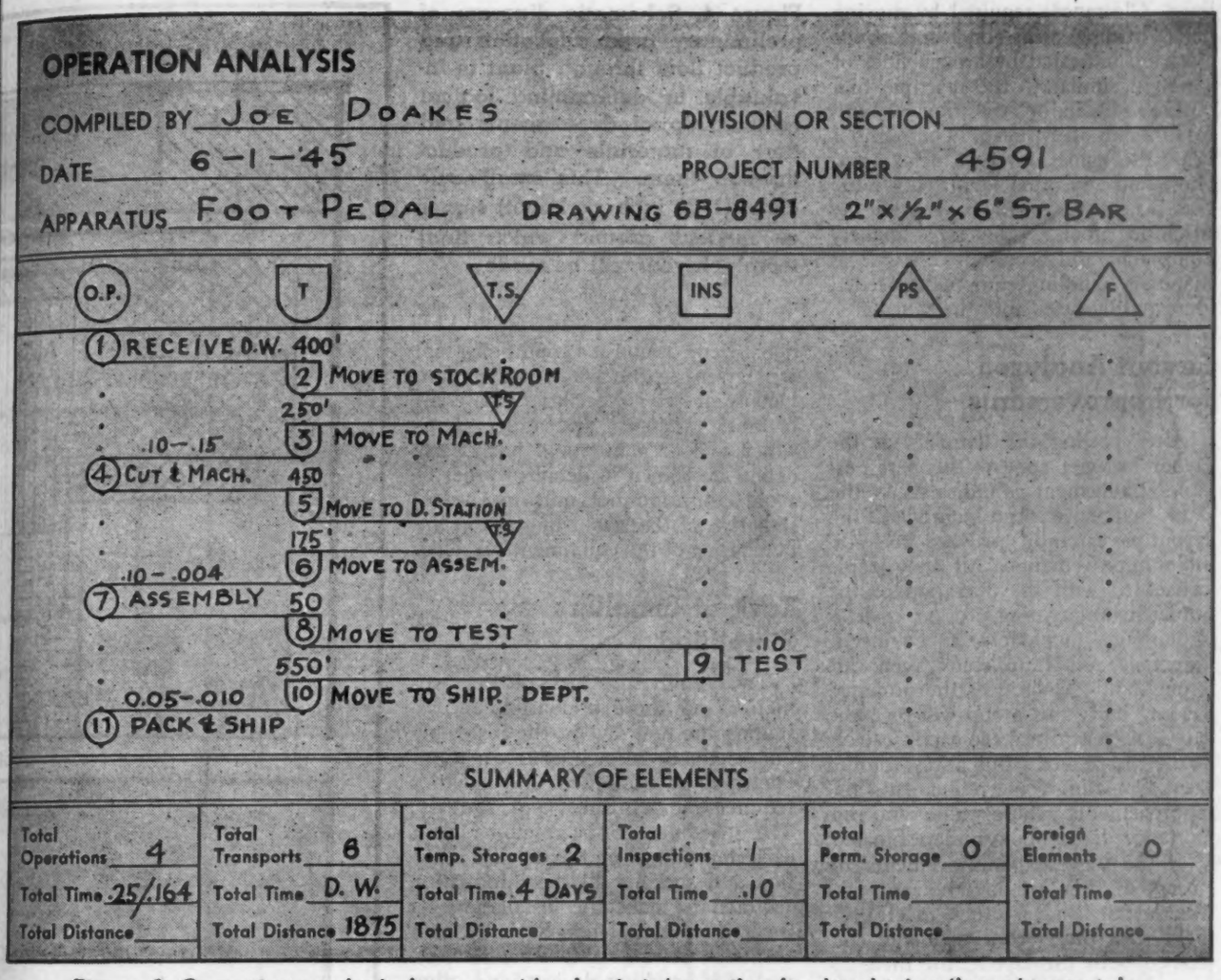


OPERATION ANALYSIS

COMPILED BY Joe Doakes — DIVISION OR SECTION

DATE 6-1-45 — PROJECT NUMBER 4591

APPARATUS Foot Pedal — DRAWING 68-8491 — 2"x½"x6" St. Bar

O.P.	T	T.S.	INS	PS	F
(1) RECEIVE D.W.	400'				
(2) MOVE TO STOCKROOM	250'	T.S.			
(3) MOVE TO MACH.	.10–.15				
(4) CUT & MACH.	450				
(5) MOVE TO D. STATION	175'	T.S.			
(6) MOVE TO ASSEM.	.10–.004				
(7) ASSEMBLY	50				
(8) MOVE TO TEST	550'		(9) TEST .10		
(10) MOVE TO SHIP. DEPT.	0.05–.010				
(11) PACK & SHIP					

SUMMARY OF ELEMENTS

Total Operations 4	Total Transports 6	Total Temp. Storages 2	Total Inspections 1	Total Perm. Storage 0	Foreign Elements 0
Total Time .25/.164	Total Time D. W.	Total Time 4 DAYS	Total Time .10	Total Time	Total Time
Total Distance	Total Distance 1875	Total Distance	Total Distance	Total Distance	Total Distance

NOTE Use ¼" per foot scale when possible. Show in detail all equipment used at this work station. For reference and analysis use Westinghouse Form 18326-A, "Operation Analysis Record." to assure that your analysis is correct. Use form 21651-A for detail of machine tool equipment. Use reverse side for additional information.

Figure 3. Operation analysis form provides basic information for developing flow of materials

gardless of whether the space will be occupied by fixed or movable equipment. At the same time, sufficient space for the operator, laydown areas, and temporary or permanent material storage areas, as well as adequate aisle space, must be considered. For this reason, work station layouts are often developed rather than more equipment arrangements.

Before an actual templet layout of the accepted area allocation chart begins, a number of points are fairly well determined in advance. Consideration of the product to be manufactured determines to some extent whether the layout will follow a process grouping form or a product grouping line. In process grouping, all like machines are located in one department or section. If product grouping is more feasible, machines are arranged in the order in which their need occurs in the manufacturing cycle. Each of these types of grouping possesses distinct advantages for certain types of manufacturing, and their use depends on the information shown on the operation anaylsis chart.

An operation analysis chart is without doubt one of the most valuable pieces of information the plant layout engineer can have. It shows clearly the different steps of the manufacturing process of a product and suggests to a great degree the form which the layout will take. The proper construction of such a chart and its use during the course of making a layout cannot be too greatly stressed.

Assuming that at this stage all the preliminary steps mentioned above have been taken, and that a course of action has been fairly well determined, the actual templet layout can now begin. Black-and-white prints of the blank floor plans are accurately laid out on layout tables of an appropriate size. Areas as indicated by the area allocation chart, previously determined by the flow line diagram mentioned earlier, are roughly blocked out, and the prepared templets are spread out according to the segregation of activities as indicated by the chart. By the use of this chart and the operation analysis sheet, the layout engineer can proceed with his layout.

Two-Dimensional Templet Developed

Formerly it was common practice to use what was known as a "block templet." It was soon discovered, however, that this type of templet was very unreliable, even for a good layout engineer, because it did not provide for proper machine clearances and failed to give an accurate representation of the machine intended.

This led to the development of the two-dimensional templet which more nearly follows the plan profile of the machine to be used, at the same time providing for all necessary clearances.

This templet is usually drawn by tracing the maximum physical contours of the machine up to a point approximately 6 feet above the floor and showing these contours in heavy solid lines. Few or none of the lines within this outline are shown except those which may be of some importance in locating the machine on the floor, such as center lines. Projections above the height mentioned and below the floor level are drawn in light broken

lines. Clearances required by moving parts, loading areas, or maintenance areas are indicated by broken lines of a weight similar to the machine tool outline. Operator's position is indicated by an arrow head. The templet bears the name and type of the machine and any other identifying numbers necessary. As the layouts of the machine tools progress, auxiliary equipment and accessories as well as materials handling equipment needed are carefully fitted into the scheme.

Layout Analyzed for Improvements

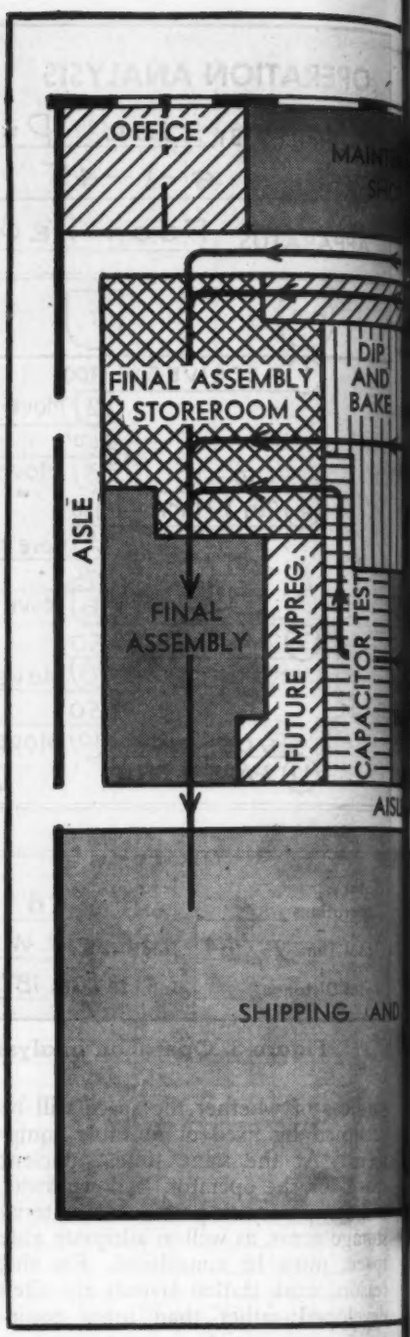
After placing the templets of the layout in what appears the best possible arrangement as indicated by the data that have been compiled, the layout is carefully analyzed for possible improvements. All the people concerned with the operation of the actual manufacturing process, such as supervisors, manufacturing engineers, foremen, and time study men, are brought in to look over the proposed layout. That this group will scan the layout with a critical eye needs scarcely to be mentioned. But always out of such a meeting come refinements and improvements whose value and importance dare not be underestimated.

If the suggested improvements are accepted, they are incorporated into the layout, and another meeting is held with those who are finally concerned with the layout, for their approval before drawings are made. Sometimes, when several templet schemes are desired, photographs of each layout are made for record purposes and comparisons.

In order to furnish the necessary information to the works engineering department or the outside contractors who will be responsible for making the actual installation, it is important that complete engineering drawings and specifications be made of the proposed layout. As previously mentioned, scale drawings are made on the floor plan first. On these drawings the layout is incorporated as approved on the templet board together with any refinements and improvements desired. Drawings are complete enough to convey all the important information required to install the new layout, so that costly mistakes and unnecessary changes during the process of installation will be avoided.

Accompanying the floor plans are additional details that cannot be properly interpreted from the drawings. For example, the designs of special benches, racks, conveying devices, and other special features are carefully shown. Elevation drawings and sectional views of unusual conditions, too, are given particular consideration. Details of service facilities, materials handling systems, and other items which a floor plan would not clearly define are shown in detail in order to avoid confusion not only in the installation of the layout but also in the purchasing of the equipment specified.

Figure 4. Schematic diagram of preliminary area allocation and product flow through plant is invaluable in determining logical relationship of departments and flow of materials and product through them. This small-scale chart (1/32 inch = 1 foot) serves as nucleus around which final templet layout will be made



Task of Installers Simplified

To simplify the task of the estimators and those responsible for installing the new layout, the plant layout engineer also prepares a form known as an equipment and facilities requirement schedule (not shown). The schedule lists in columnar form each item shown on the detailed drawings and specifies all the information required to make the installation for each item complete. Such requirements as power, light, other services, materials handling devices, and other pertinent data are shown for each individual item so that not a single thing is overlooked during the installation.

Use of this schedule not only minimizes the possibility of error or oversight, but also saves much time and makes unnecessary the continual scrutinizing of the drawings to determine the materials as well as the work necessary to install the layout. For the estimator it is extremely valuable in figuring the cost of the job because he can quickly estimate such items as power loads and service facilities.

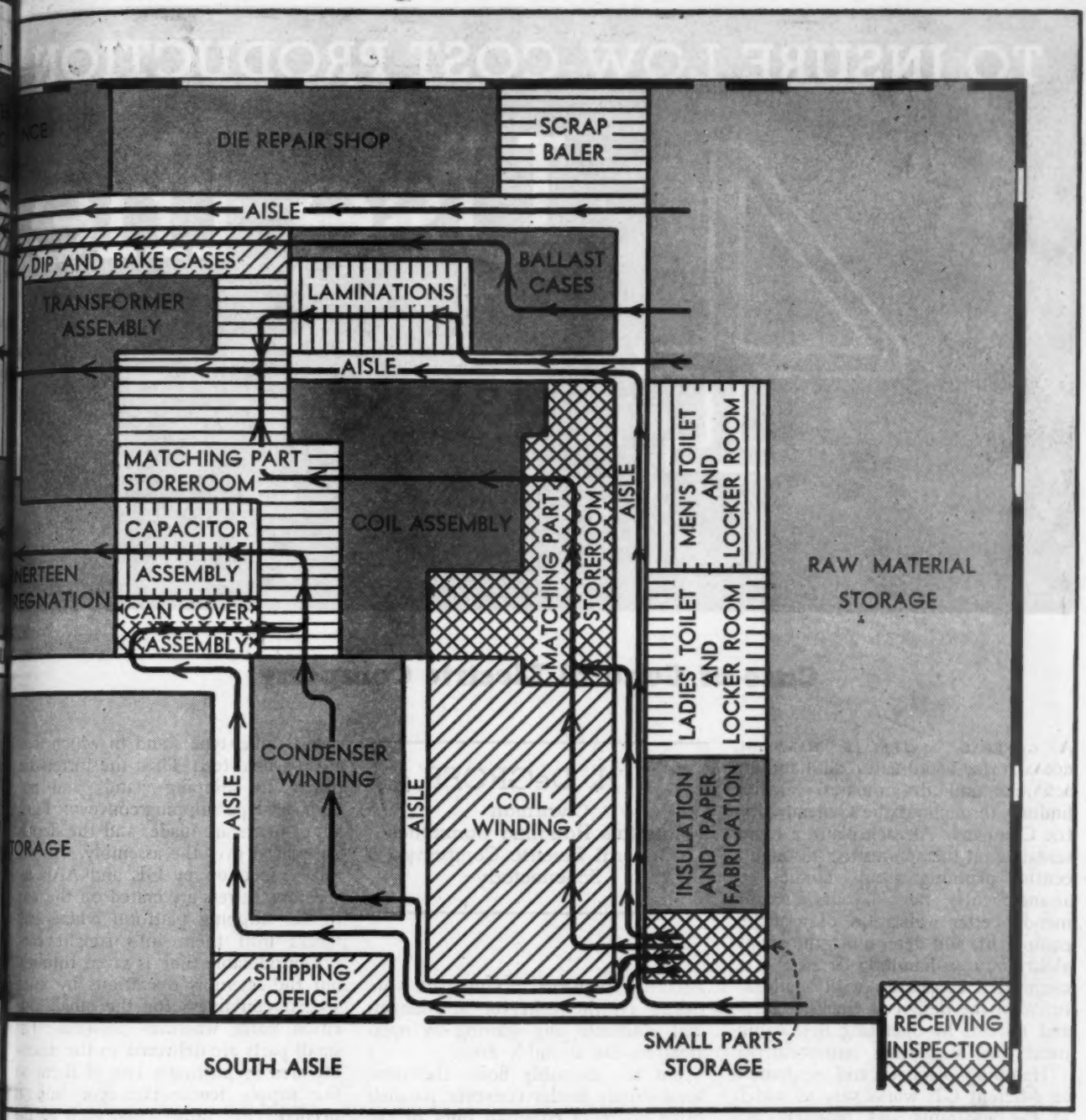
Only when all this information has been prepared, checked, and properly approved, can the actual installation of the layout begin.

Scale Models Found Superior

The Westinghouse headquarters plant layout staff has done considerable pioneering in the use of three-dimensional models for layout purposes. These models differ from the two-dimensional templets and the three-dimensional blocks used by some companies, in that they are accurately engineered and detailed scale-model reproductions of the machines and equipment they represent.

A scale model of this kind combines the special characteristics of each type of machine, so that the standard machine designs of various manufacturers are easily recognizable. A method of developing these models for less expensive simplied production is now in progress.

The greatest advantage gained from the use of these models for plant layout work lies in the fact that they produce in the observer a greater awareness of the proposed layout, because of its third dimension, than is possible with the flat type of representation.



This advantage is particularly great when a layout must be shown to, and approved by, groups of persons who are not entirely familiar with reading conventional drawings. Since the three-dimensional layout need make no allowances for the element of abstraction always present in the other form of layout, nothing is left to the imagination of the observer.

In Westinghouse practice, the superiority of the scale model layout over the conventional flat templet layout has been effectively demonstrated on numerous occasions. This method is not in general use, however, but is employed only where the complexity of the layout justifies. When accurate models are more readily available, it is anticipated that a broader use will be made.

For a quick efficient use of this method, it is suggested that a stock bank of scale models of all the standard machine tools and equipment in the plant be stored handily, properly labeled and identified, in suitable compartments or bins in the layout room for ready access when a layout is contemplated. Scale models of special tools, auxiliary equipment, furniture, and other needed items can be made and finished to suit as required.

As to the matter of cost, it has been clearly established that, although the initial cost of the models may seem high, the total cost of the finished layout, principally because of the hours saved in planning and discussion, is considerably less. For example, in the process of eliminating the "bugs" from a layout, a draftsman may be required to cut several sets of paper templets and even redraw a plan a number of times on account of lack of complete understanding on the part of some of the people who must approve the proposed layout. All this is eliminated by the use of models, and if more than one scheme is to be submitted, a duplicate set of models is used or a photograph is made of the proposed layout—which serves as a very satisfactory record.

TO INSURE LOW-COST PRODUCTION

4 Use the M

Case of General Electric Company

J. H. DeGROFF
Chairman
Materials Handling Committee
General Electric Company
Schenectady

A GENERAL MATERIALS HANDLING COMMITTEE coordinates all handling activities and disseminates valuable findings throughout the General Electric Company. At each plant, a representative on the committee, through a central planning group, studies rearrangements, new layouts, recommends better utilization of available equipment, and determines the adaptability of new handling devices. The committee cooperates with manufacturers in the design of trucks, trailers, and tractors by operating new equipment and suggesting improvements.

Handling practices and equipment at different GE works vary as widely as the apparatus and products produced by the company. Some examples are presented in this article.

Turret Assembly

Several conveyor systems, as well as a number of special racks, containers, and pallets, are used in connection with the large-scale production of gun turrets for the B-29 at the Erie Works. An overhead conveyor delivers parts for the turret from a second-floor stockroom to the assembly area on the first floor. The parts are many in number and of a wide variety of shapes, sizes, and weights. Specially designed hangers are employed to suspend each of the oddly shaped parts on the conveyor in the proper assembly sequence. The parts are spaced on the conveyor at intervals that eliminate any waiting by operators on the assembly floor.

On the assembly floor, the overhead supply feeder conveyor parallels three assembly conveyor lines of the drag type. The drag-line conveyor moves along at the rate of 7 inches a minute. Assembly operations are facilitated by special assembly stands arranged to be pulled along by the conveyor. At the start of the conveyor line, the inner and outer rings of the turret and its saddle and saddle supports are placed in the stand as the first assembly operation. As the stand moves along with the drag line, other parts—azimuth and elevation drives, booster motors, wiring, ammunition cans, fire interrupters, and so on—are added to complete the assembly. The turret is inspected at the end of the conveyor line while it is still on the conveyor. It is transferred from its assembly stand to a special roller-type stand in which it is given a final test. Then the turrets are placed in shipping stands and put on a slat-type shipping conveyor. Final adjustments are made, and the domes are placed over the assembly. After a final inspection by GE and AAF inspectors, turrets are crated on the way to the shipping platform where fork trucks load them into freight cars.

Considerable time is saved throughout the assembly operations by using special containers for the small precision parts, wherever possible. The small parts are delivered to the assembly area by putting a box of them on the supply feeder conveyor line as needed. For some parts, such as the compressor assembly, special racks are used on the assembly floor as well as in the stockroom. In every case, the objective is to systematize and minimize handling.

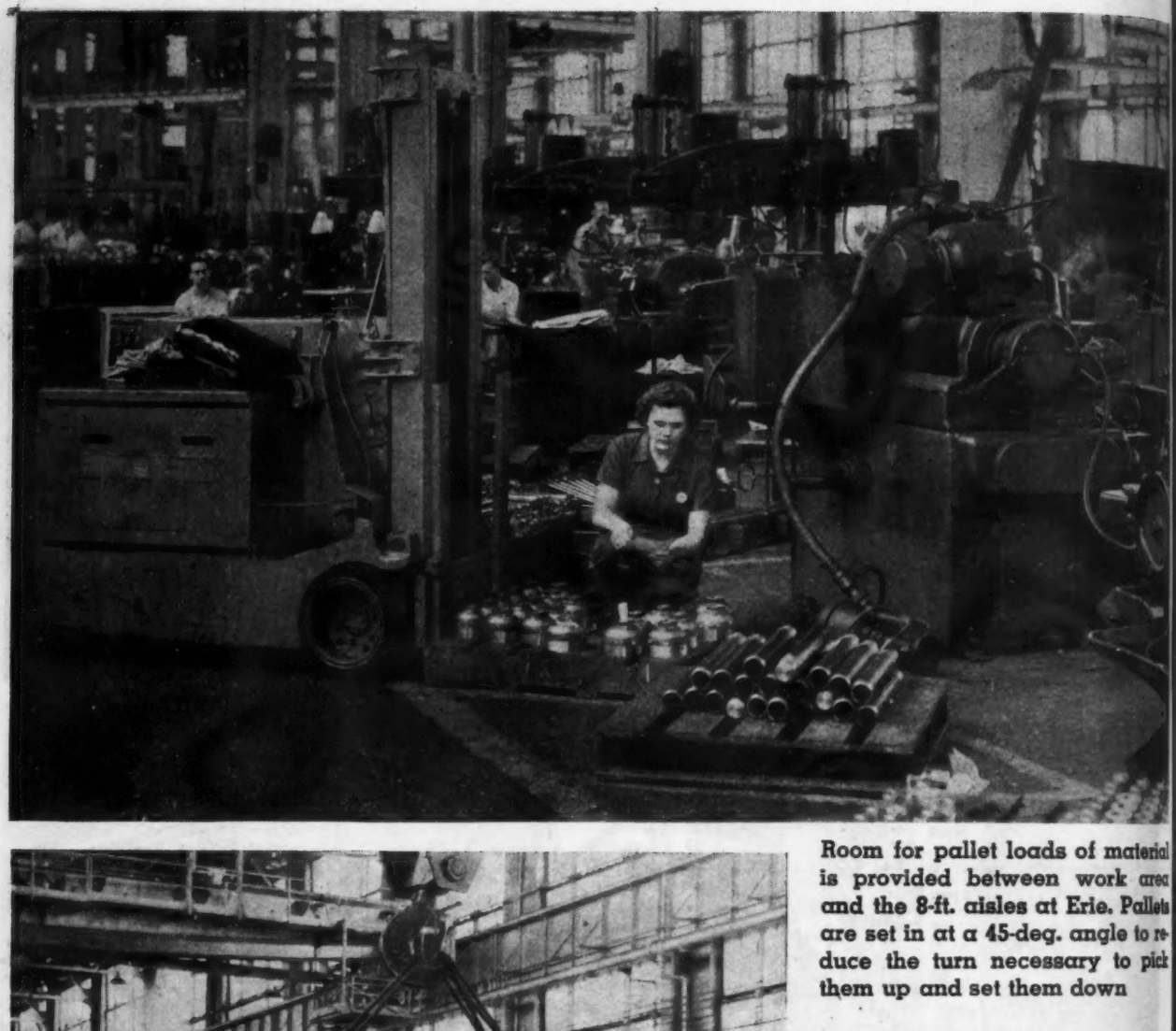
Standardization Keynote

For other than conveyorized movement, the formula for efficient handling at the Erie Works is simple —standardization of methods and equipment.

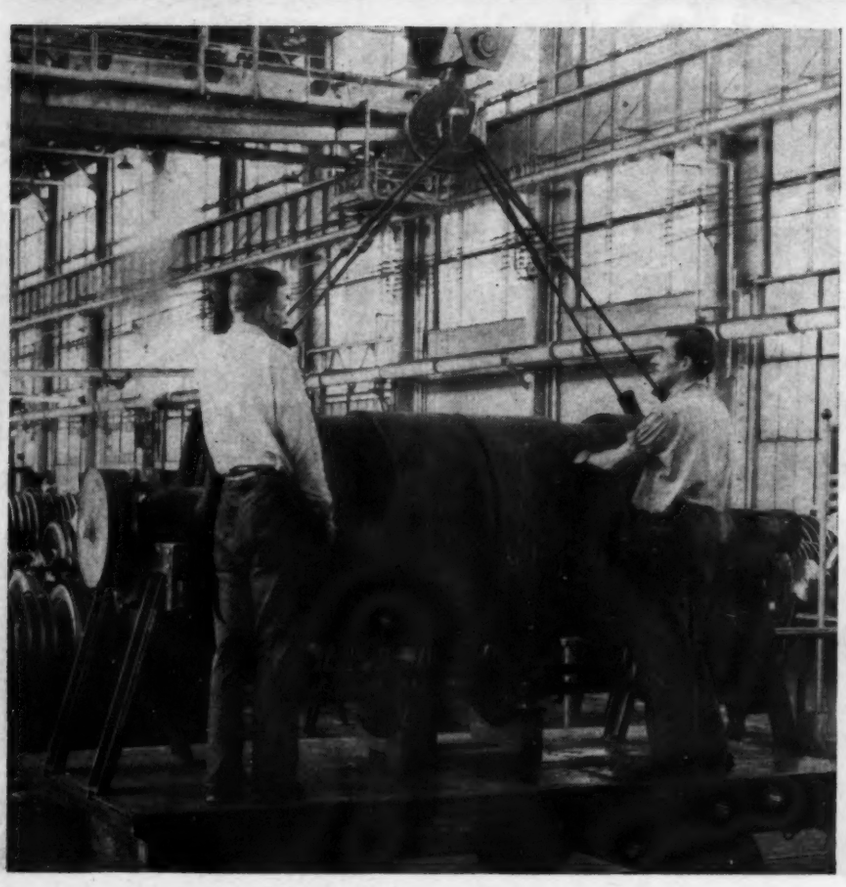
The Works covers approximately half a square mile, containing about 27,500 linear feet of paved roadway, about 11½ miles of standard-gage railroads interconnecting the various shops, and another 3 miles of track

e Most Effective Handling

On the turret assembly floor at the Erie Works, an overhead supply feeder conveyor parallels three assembly drag conveyor lines. Assembly is facilitated by stands pulled along by the conveyor



Room for pallet loads of material is provided between work area and the 8-ft. aisles at Erie. Pallets are set in at a 45-deg. angle to reduce the turn necessary to pick them up and set them down



Heavy material calls for cranes. For instance, big forgings for turbine rotors are handled by crane and a special saddle car

within the buildings. Approximately 650,000,000 pounds of materials per year pass through the Works. The materials vary in weight from a few pounds to more than ten tons, and, in the manufacturing processes, must be moved distances ranging from a few feet between machines to more than a mile between buildings.

The two general methods of handling that have been adopted as standard are both based on the unit load principle. Generally speaking, the pallet-fork-truck method is used for handling materials with a unit weight of not more than three tons. Heavier material and material too bulky for pallet handling, such as bar stock, is handled by crane. Big forgings for turbine rotors are handled by crane or a specially designed saddle car.

Standardizing on two sizes of pallets has facilitated the pallet-fork-truck method. The two pallet sizes are 4x4 and 3x3 feet. There are three general weight groupings of materials: 1, 2, and 3 tons, which have permit-

ted standardizing on three corresponding sizes of fork-lift trucks.

Each division of the works has standard industrial truck equipment consisting of (1) one or more fork trucks of any one, two, or all three sizes, (2) a number of pallet-handling hand-lift trucks to supplement the fork trucks, and (3) a burden-bearing truck for maintenance work in the distribution of bar stock. Each building has a main crane servicing its entire length. Small motorized boom arm cranes are installed where needed. Automobile trucks are used for handling between some buildings.

Standardized handling at Erie begins right at the front door, so to speak, by palletizing incoming material as it is received and taking it to the point of use or storage by fork truck. But, wherever possible, the trend is to go even beyond the front door by enlisting the cooperation of vendors to ship palleted, unit loads of materials. Real time savings can be made when materials are received on pallets in the standard units of 1 to 3 tons. Conversely, considerable time is saved when the consignee is equipped to receive in unit loads.

A 4x4-ft. single-face pallet was adopted as standard for the job. A four-sided bin, with dovetailed corners held together by large corner staples, is assembled on the pallet. By applying two steel straps girthwise, and two more running in the direction of stringers, a sturdy container is provided which will hold up to 3 tons of castings. Movement of the castings during shipment does not create stresses sufficient to break through the sides of the bins.

The bins are loaded two wide and two high in the freight car by fork-lift trucks, making up a carload of 24 bins. Although the upper and the lower tiers are fastened to side-strapping in the car, the load is free to float, and experience has proved that the free movement causes no damage in shipment. Time required for loading a car averages around 12 man-hours, about 100 man-hours fewer than when the castings were handled individually. A big advantage of this system lies in the fact that the bin containers can be easily knocked down for return and re-use simply by freeing the straps and removing the staples.

Storage yards equipped with craneways adjoin each of the shops at Erie. Roadways and railways intersect the craneways and connect with craneways within the building, simplifying transfer of materials from one handling facility to another.

One major rule has been followed in laying out these storage yards: Enough space is allowed so that it is unnecessary to stock more than one kind of material in one pile. As a result, any material in any yard is readily accessible.

This does not mean that every square foot of space is not efficiently utilized. Space beneath the yard crane runways is utilized for pallet storage. This space, which is useless for crane storage, amounts to as much as one-sixth of the total craneway area.

Standard handling practice within the shops is to provide space for storage of incoming material, finished parts, and subassemblies. In addition, room for two pallets at a 45-deg. angle is reserved between the work area and the aisle. The 45-deg. angle reduces the turn necessary to pick up and set down.

Immediately inside the receiving and dispatching doors of each shop sufficient space is provided so that loading and unloading can be done promptly.

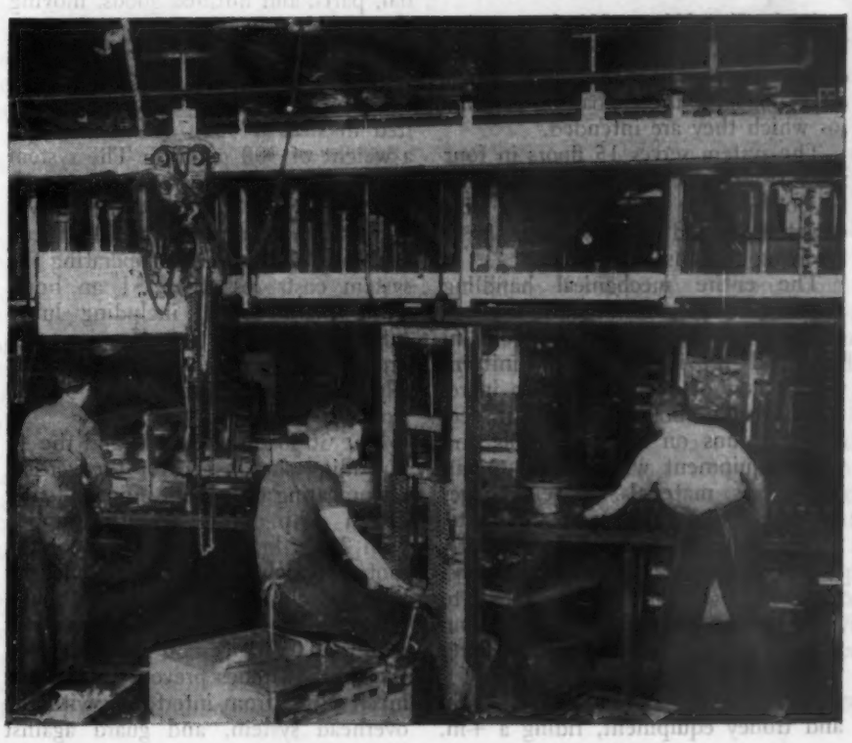
Eight-foot aisles, plus the adjacent space for pallets at a 45-deg. angle, have been adopted as standard. Buildings erected during the past several years have been laid out accordingly, and, when practicable, existing buildings are rearranged on the basis of this standard.

Each shop is zoned, with one or more trucks assigned to each zone. Responsibility for dispatching the trucks lies with the storekeepers. Truck operators execute move orders from the storekeeper individually in relatively light traffic zones. In dense traffic zones, the truck operators work according to orders moving with the load.

Several shops have found that shelves for pallet loads are the best answer to the problem of in-process storage of assorted small lots of materials. The shelves, usually three-tiered, conserve space, and are readily accessible to fork-lift trucks.

Classified storage racks, with crane handling, is used in shops requiring bar stocks. Burden-bearing trucks are employed to carry bar stock from the storage yard craneway into the shop. Accumulating trays are used in several shops for making up assortments of small finished parts for delivery to assembly areas.

In the foundry, castings are taken through rough-grinding and inspection operations in skid boxes by platform-lift trucks. The pallet-fork-method is replaced here primarily because of the heavier and bulkier loads, and because tiering is not a factor. But the method is readily integrated with pallet handling when castings are dispatched from the foundry,



Transfer station at Fort Wayne where all three overhead chain systems converge, permitting an interchange of loads. Outgoing and incoming lines are connected by a table with a roller conveyor top. Two operators constitute the normal force at the transfer point

simply by putting the castings into pallet boxes at the last inspection.

A crane truck is available for special handling duties in any of the shops. It served its purpose excellently not so long ago when additional manufacturing space required in the motor shop reduced available storage space. Neither the armatures nor motor frames involved could be stored readily on pallets. They had been stored under the craneways. A nearby storage shed was available, but it had no crane facilities. Coordination between fork lifts and crane trucks made it serviceable.

Armatures and frames are delivered on pallets to the shed by fork lift trucks. The crane truck sets the armatures in racks and elevates the frames for piling.

The unit load technique is used for handling salvage as well as incoming materials at Erie. For example, approximately 350 carloads of machine turnings are returned to steel mills annually. They are accumulated in the various machine shops in steel trays, which are loaded either on industrial flat cars or on highway-type trailers for delivery to salvage.

Plant rubbish is handled similarly. Large semi-trailers with 16-ft. steel bodies and a 7-ft. inside width are spotted at approximately 75 pick-up stations. When hauled to the salvage department, they can be turned at any angle up to 90 degrees and hoisted to a 40-deg. dumping angle.

Overhead Conveyor

At the Fort Wayne Works an overhead conveyor system features carriers equipped with tab mechanisms which direct loads to the unloading stations for which they are intended.

The system serves 15 floors in four multi-story buildings. An operator at any one of 36 sending stations may dispatch a load to any one of 49 receiving stations.

The entire mechanical handling system is one that was designed specifically for the production job involved. It provides a smooth, uniform rate of flow of raw materials in increments small enough to permit economical runs on machine tools and other equipment without accumulating excess materials. It encourages immediate disposal of scrap and waste, while finished parts are promptly transported to assembly sections. Completed motors are delivered to the shipping department, packed and ready for shipment, 20 minutes after passing final inspection.

Basically, the system utilizes chain and trolley equipment, riding a 4-in. I-beam and supporting a carrier big enough to handle three standard sizes of stocking boxes. There are three separate loops in the system, 2800, 4880, and 2304 feet long, respectively. Each loop is laid out to reach and tie together closely related departments. The system is designed so that each department is reached consecutively according to the flow of work in process. Haul and elapsed time is minimized, as well as the quality of material, parts, and finished goods, moving along the chain.

The conveyor travels 60 feet per minute, with carriers spaced 16 feet apart on the chain. Carriers are limited in size to 32x17x13 inches and a weight of 300 pounds. The system is powered by ten 7½-hp. motors, each equipped with caterpillar drive, synchronized through a variable speed transmission. Power for operating the system costs less than $1 an hour, while maintenance, including lubrication and installation of minor improvements, runs about $7000 annually. The system utilizes some 32,000 stocking boxes.

The 36 loading stations and the 49 unloading stations are of the vertical reciprocating type, with independently driven ¾-hp. motors and equipped with 20-lb. brakes. Operation of the motor at each station is controlled by limit switches which function through relays to start and stop the motor as required. With certain safety devices, the limit switches prevent the station mechanisms from interfering with the overhead system, and guard against oversized loads being placed on the conveyor.

The tab arrangement used to deliver the boxes properly to a predetermined station is the most outstanding feature of the conveyor system. Actually, the tabs are hinged steel lugs—six of them on each side of the carrier box. Tabs on one side represent a floor or department; tabs on the other side represent a numbered station. The respective combinations of tab settings actuate a control mechanism at the desired unloading station. The control mechanism consists of a limit switch on each side of the overhead system in the path of the tab mechanism. When both limit switches are closed by tabs, the motor circuit is closed through relays, an unloading mechanism removes the load from the carrier, clears the tab setting, and lowers the load on a gravity conveyor to a convenient working level.

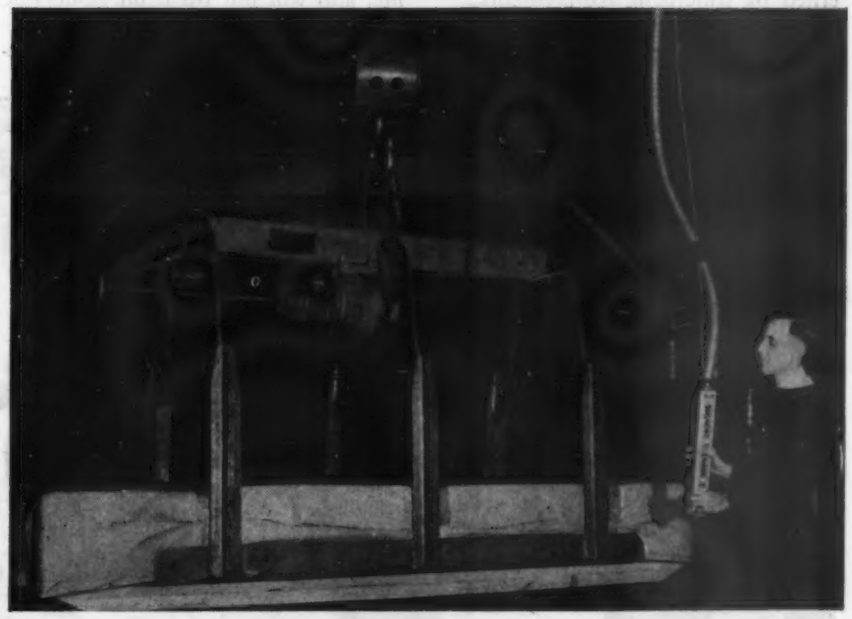
At the loading station, the system is a little more involved but just as foolproof. Boxes raised from the working level by gravity conveyors are picked up by the first empty carrier on the conveyor. The unloading point is determined and set from below by a solenoid system controlled from the loading station by setting a dial mechanism. This causes lever arms to extend into the path of the tab mechanism on the side of the carrier as it loads, and sets up combinations of tabs on the carrier to select the unloading point.

Each loading station is equipped with a dial control, so that any oper-

Pallets (opposite page) are used for storage wherever possible, in the order and stores building at the Schenectady Works, so that materials may be moved quickly when called for

Copper and brass are stored (left) on racks, whose arms are adjustable to different spacing. Stock is received on boards and is placed on the rack by a push-button controlled overhead crane

Special grab (below) is used to move bundles of sheet steel from railroad cars shunted into the building, to the storage area. The grab is operated in conjunction with pushbutton controlled cranes running crosswise in the building



ator at any sending station may dispatch a load to any receiving station. If the destination selected is on the same loop as the sending station, the load goes direct. If not, it goes through a transfer station in the basement. The transfer station is reached by all three chain systems and permits an interchange of loads between the systems. Outgoing and incoming lines at the transfer station are connected by a table with a roller conveyor top. The infrequent errors made by the conveyor system or operators are easily corrected at the transfer point. Likewise, it is a positive check that no material is lost on the system. Two operators constitute the normal force at the transfer point.

A panelboard, adjacent to the transfer station, indicates whether all sections of the conveyor system are working properly. Trouble on any section will dim telltale lights on the panelboard, and send a maintenance man to the source of trouble. The board is the only point at which the conveyor chains can be started or restarted, although, of course, they may be stopped by emergency buttons at every station.

An electric hoist at one end of the transfer table is the link between the conveyor system and a midget-type fork truck which serves an adjacent stockroom. The truck can tier stocking boxes in the storeroom to a 72-in. height, providing economical storage and handling. The combination of conveyor system, standard-sized stocking toteboxes, together with small fork trucks with special scissor action forks to grasp boxes under stocking ledge, has provided a flexible efficient handling system.

Built for Handling

The order and stores building at the Schenectady Works is an example of a structure built for maximum efficiency in handling materials. Throughout, its design reflects careful planning for progressive movement of materials and economical handling methods.

Completed in 1941, the building is 240 feet wide and 560 feet long, providing a floor space of approximately 134,000 square feet. It is a one-story structure except at one end, where a second floor provides office space.

Along the incoming side of the building, facilities have been provided to accommodate as many as ten truck trailers and eight railroad cars at one time. At the opposite side of the building, six truck pits are provided for distribution purposes. All truck pits are equipped with pushbutton controlled curtain doors. The receiving bay is served by two 5-ton cage-controlled cranes for 400 feet of its length, and by three 5-ton floor-con-

trolled cranes running crosswise through the building.

Ramp entrances into the building have been correctly graded to facilitate movement of fork trucks, tractor trailer trains, and other mobile materials handling equipment.

It is unusual for an item to remain in the order and stores building for more than 30 days. In many cases, materials are distributed to their respective destinations the same day they are received. In such cases, the materials are placed on standard-sized wooden pallets. Then, after the material has been checked and marked for delivery, the palletized materials are loaded on trailers by fork truck. The procedure is equally simple for material that is stored temporarily in the big building.

So greatly does the palletized method enhance efficient handling, that vendors are asked to ship their materials in palletized unit lots, wherever practicable. For the same reason, ordering procedure, as far as quantity is concerned, is largely governed by palletizing requirements.

Storage facilities are designed to simplify handling. Many of the different types of racks and bins for storing bar stock and hardware have been specially designed.

Hardware racks contain retail stocks of such items as bolts, nuts, and screws, the type of rack being governed by the kind of material stored. Retail metal stocks in rolls and coils are stored in racks of a demountable type. Retailing from hardware racks is accomplished from the front end of the aisles, the racks are replenished from the rear.

Bar stock is retailed from racks equipped with liners to expedite racking operation. The racks are demountable, and sections may be added or removed without altering the main units.

There are several types of wholesale racks, varying according to the kind of material stored. A "Christmas tree" rack with a 90,000-lb., or carload, capacity has proved especially useful as a single unit designed for heavy loads of bar steel. The rack is served by overhead crane, and easily moved when empty. It is self-balancing, and will not tip if only one side is loaded.

The racks used for storing wholesale copper and brass are very flexible. Their arms are adjustable to different spacing, and additional sections can be added easily. These racks are served by a pushbutton controlled crane.

Stack bins have proved particularly valuable where large stocks of a fast-moving item must be stored. Racks of this type permit slings to be attached readily. They are also useful for storing temporary stocks in volume and are removable in sections.

A special grab is used to move bundles of sheet steel from the railroad cars shunted into the building to the storage area, and for subsequent handling when the material is called for. The grab is operated in conjunction with the 5-ton pushbutton controlled cranes running crosswise through the building.

Progressive Packing

A progressive packing system employed at the Philadelphia Works is a good illustration of how a roller floor or conveyor track can be used to advantage for certain types of handling.

Switchgear equipment, ranging from small oil circuit breakers to large

When heavy equipment is ready to be packed for shipment at the Philadelphia Works, it is lowered from the assembly section one floor above to the delivery track of the roller floor conveyor, and taken to the packing track, which has stations for progressive packing operations along each side. For detail of roller floor conveyor, see picture at right

substations, is packed for unit shipment. Some of the equipment handled is as large as 21 feet long and 8 feet wide, and weighs up to 21,000 pounds.

The roller floor conveyor track is laid out in the shape of a "T." The top of the T is the delivery track, and is located in an area under a high-bay crane where the equipment is lowered from the assembly section one floor above. The delivery track is 68½ feet long. The leg, or upright, of the T conveyor is 165 feet long. This section constitutes the packing track, with stations for progressive packing operations arranged along each side. A heavy-duty scale with rollers in the platform completes the conveyor track.

The rolls are set in an angle iron framework, clearing the concrete floor by ½ inch. Each roller supports a weight of more than 500 pounds. Each part of the T is made up of two double tracks of staggered rolls 4 feet wide, separated by a 2-ft. walkway.

The first operation performed after a piece of equipment is moved from the delivery track to the packing track, is the application of interior blocking. Next, a paper covering is applied, and the sides and ends of the roof are nailed on. After weighing, the address and other necessary markings are applied. Then a fork truck pulls the packed equipment from the track and loads it for shipment.

The conveyor track system permits efficient delivery of a great variety of material from the assembly floor. Formerly much of the equipment was brought down by electric platform trucks, using elevator facilities which became overtaxed by an increasing volume of equipment which had to be handled.

The conveyor system has eliminated unnecessary lumber handling in the packing section. Lengths of timbers are standardized and the lumber is placed along the packing track according to use sequence.

A dividend, in addition to better handling, is that quality of the packing job has been improved. Assigning one group to each packing operation developes proficiency all along the line.

The progressive packing system has considerably increased the volume of equipment that can be handled, but at the same time it can be used profitably if volume of equipment is light.

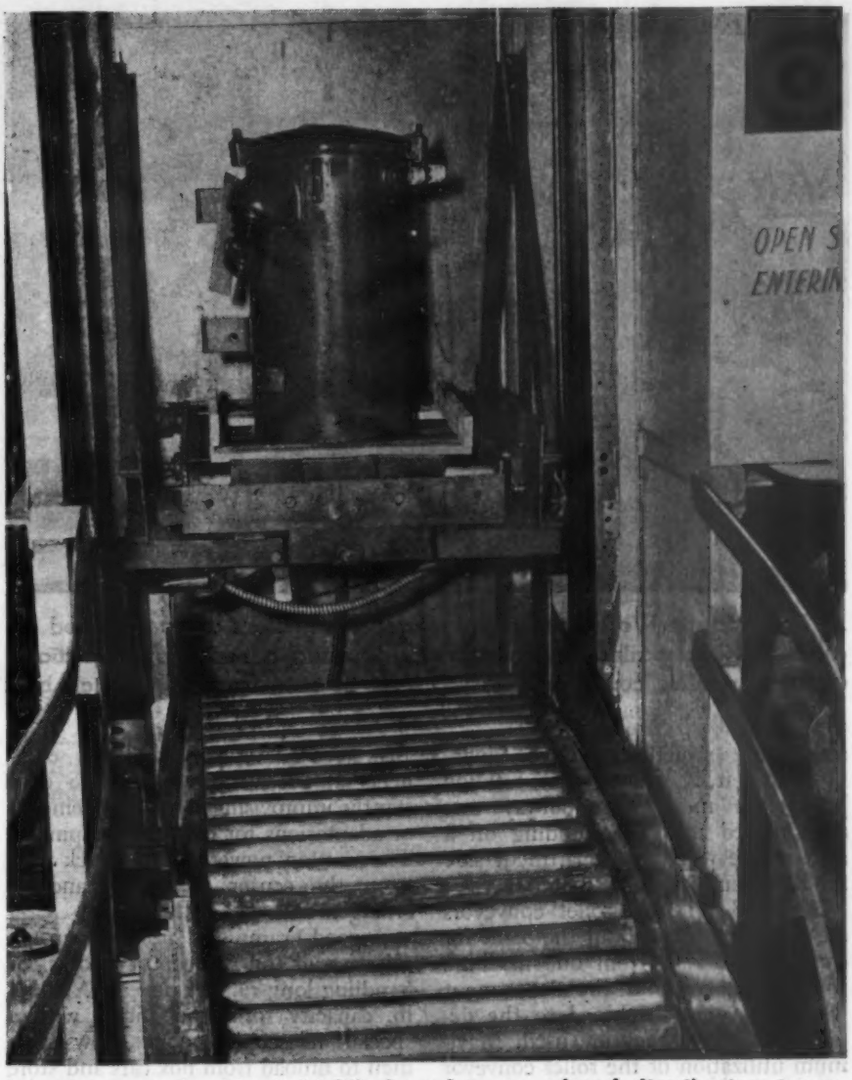
Transformer Conveyors

Distribution transformers are manufactured at the Pittsfield Works in a multiple-story building. All sizes, from 1½ to 25 kva., are handled completely on a roller conveyor from the time the coils are wound. All operations are conveyorized, including tank welding, coil and tank assembly, and testing. From the assembly point, the transformer rolls in its final shook to the packing department. There the completed transformers are crated and loaded on a semi-trailer for delivery to the warehouse.

The entire conveyor system consists of approximately 1200 feet of gravity and power-operated conveyor. Five contributing lines converge into one main line on the second floor. Each contributing line deposits a certain number of transformers at a time on the main line, thus keeping any one of the five lines from becoming congested.

The main line leads to a lowerator by which the transformers are carried to the first floor. The lowerator operates automatically and is capable of delivering 100 transformers per hour from the second floor to the first floor.

From the lowerator on the first floor, the conveyor leads through the entire length of the shipping section, where the transformers are crated on the conveyor. The conveyor line continues to the outside of the building where the finished transformers are loaded onto semi-trailers and delivered to the warehouse.



Lowerator at the Pittsfield Works takes completed distribution transformers from roller conveyors, delivers them to waiting trailers

Turbo Conveyors

Manufacture of turbosuperchargers in large quantity for the AAF requires a number of progressive machining and inspecton operations for certain parts, especially the impeller. The turbosupercharger plants at Everett, Mass., and at Fort Wayne, Ind., were planned to utilize roller conveyors for most efficient handling from operation to operation.

The Fort Wayne turbo plant, largest of any single GE building, covers more than 788,000 square feet. A

At Fort Wayne Works, turbosupercharger impellers are assembled on a special box pallet by operators performing a series of operations along the roller conveyor. Parts travel in two drawers in each box

single-story structure, almost square in shape, it is laid out for full-line production methods. Railway cars are shunted into the building on a spur at the receiving department side for direct unloading of materials.

About 3 miles of roller conveyors are employed throughout the plant for carrying materials from one machine to another, or from the department where they are machined to the department where they are used. Maximum utilization of the roller conveyor system is achieved through planned alignment of the machines.

Turbosupercharger impellers are built up on a special box pallet by operators performing a series of operations along the roller conveyor. Parts that the operators use in assembling the impeller are contained in two drawers in each of the boxes. Larger parts for the turbos flow along another movable rack to the rear of each worker.

After the impeller and shaft are assembled into the housing of the turbo proper, the whole assembly is mounted on a trunnion stand for the remainder of its trip along the conveyor line. Parts assembled to the exterior are added, and the turbo finally reaches the packing department a completed unit.

Special Handling

There's no holiday for ingenuity in materials handling, and where special methods or equipment are required and justified, an unusual answer to a handling problem is often the best answer. Materials handling engineers at the various works are constantly improvising new arrangements or adaptations for existing equipment. The battery-powered lift truck has been the center of many handling arrangements.

A good example is shown by an application at the Bridgeport Works for handling long rolls of paper. A 4000-lb. capacity fork truck fitted with a special telescopic boom allows two men to unload from box cars and store 200 rolls of paper per day. The rolls, 10 feet, 3 inches long, weigh 1000 pounds each.

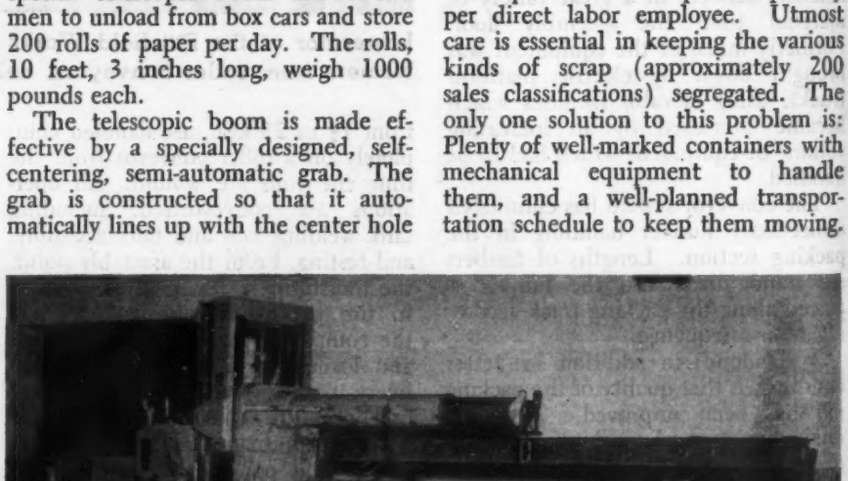
The telescopic boom is made effective by a specially designed, self-centering, semi-automatic grab. The grab is constructed so that it automatically lines up with the center hole of the roll of paper when lowered over the roll by the fork-truck operator. Another man on the floor swings the opposite end of the grab into the center hole of the paper.

Rolls can be loaded as easily as they are unloaded. The floor man turns the roll approximately 45 degrees as the fork truck goes through the freight car door. Then he maneuvers the roll into a straight forward position again as the truck turns toward either end of the car. As many as 76 rolls have been loaded into a 50-ft. freight car with the boom-equipped fork truck. Rolls can be stacked as high as 119 inches with the equipment.

Scrap Handling

When it is realized that approximately 20 percent of the raw materials that go in the front door of a manufacturing plant go out the back door in the form of scrap, it becomes obvious that it is time to take scrap out of the class of a "necessary evil" and give its handling the same careful study and planning that production materials get. In the General Electric Company's operations, marketable waste products amount to 185,000 tons per year—well over 100 carloads a week. This does not include the shop refuse that finds its way to incinerators and dumps.

Scrap is everywhere. It is generated on nearly every machine tool throughout the shop and is produced at the rate equivalent to 25 pounds per day per direct labor employee. Utmost care is essential in keeping the various kinds of scrap (approximately 200 sales classifications) segregated. The only one solution to this problem is: Plenty of well-marked containers with mechanical equipment to handle them, and a well-planned transportation schedule to keep them moving.



Fork truck fitted with telescopic boom allows two men to unload from box cars and store 200 rolls of paper per day at the Bridgeport Works. Rolls are 10 feet, 3 inches long, and weigh 1000 pounds

Hand-sorting is an expensive, but necessary, operation for some types of scrap. Accumulation containers, supplemented by portable sorting tables, aid in segregation. When containers are filled they are tiered to the roof by a fork truck, held until there is enough to make a carload shipment

The quantities, kinds (ferrous or non-ferrous), and forms (solids or turnings) determine pretty much the methods of handling, and in general all salvage operations should be handled at one location in the plant. The equipment to be utilized in the salvage section should be selected with this in mind.

The problem of handling scrap resolves itself into two main operations: First, collection at the source of production and transportation to the salvage section. Second, the handling of scrap in the salvage section during unloading, inspection, preparation, storing, and finally loading for shipment to the steel mills, foundries, smelters, and other users.

For example, in one installation, small totepans of scrap from numerous locations in a six-story building housing small motor manufacture are delivered by conveyor to the basement. The totepans are emptied from the conveyor to the large accumulation containers underneath the grating. Approximately twelve sortings are made at this point without additional handling. The large containers are placed on trailers or flat cars with an industrial truck for the trip to the salvage section, where the ferrous scrap is put in bins for outdoor storage. The transfer from containers to bins is accomplished with a magnet on an overhead crane. When carloads are accumulated, the material is loaded in outgoing gondola cars with the same magnet.

When large accumulations of scrap are produced in one location by a battery of machines, the material can go directly into the large containers for delivery to the salvage section bins. In some cases the scrap is delivered direct from the large drop-bottom accumulation containers to the outgoing cars by means of a fork truck.

The second phase of scrap handling occurs in the salvage section itself. Although 85 percent of the scrap handled is ferrous and only 15 percent non-ferrous and non-metallic, handling costs are larger in the latter classifications. All the material must be inspected for contamination and in many instances hand sorting is necessary. Furthermore, because of the many classifications of non-ferrous scrap and the relatively low rate of accumulation, it is necessary to provide storage for a large number of items until carloads are available.

Perhaps the most economical and flexible equipment for this work consists of large accumulation containers which are handled with fork trucks equipped with revolving forks for dumping purposes. These trucks permit inspection of brass turnings for contamination as received from the shop. Here is an example of minimum handling: One man, the driver of the truck, unloads the container of turnings from incoming yard trailers, dumps the turnings from one container into another while inspecting the contents, and then tiers the boxes in storage for carload accumulations. When shipping the material to the smelters, he removes the containers of turnings by elevating the forks of the truck, weighs the material, and finally dumps it direct into the box cars. The whole operation is handled with mechanical equipment by one man. Compare this with the many handling and shoveling operations if the material were binned in storage and consider the number of bins and floor space that would be necessary.

The accumulation containers also serve to receive hand-sorted scrap when supplemented with portable sorting tables. Here again, when the boxes are filled they are tiered to the roof by the fork truck and held for sufficient quantities to make carload shipment to the smelters.

Shop refuse is a real headache to management, but the handling problem can be simplified by placing special underslung semi-trailers at the rubbish stations in the plant. The sweepers can easily deposit the materials into the trailers from ground level. One truck-tractor equipped with a fifth wheel hoisting mechanism for dumping the trailers at the incinerator can service ten or twelve semi-trailers.

TO INSURE LOW-COST PRODUCTION

5 Practice

Case of Radio Corporation of America

I. K. KESSLER,
Supervisor
Wage and Salary Administration
RCA Victor Division
Radio Corporation of America
Camden, N. J.

INSTALLATION of the work simplification program at the Camden Plant of the RCA-Victor Division in 1940 was facilitated because management not only backed it, but also requested it. Interested in continuing and developing its program for improving shop performance and reducing costs, the management decided work simplification was needed, looked around for the proper individual to introduce it, and selected Joseph H. Quick, then head of the radio cost control section. Quick attended a well-known summer conference, and upon his return planned and installed the program herein described.

The support of all levels of supervision was secured by arranging courses first for top levels, followed by others in descending order, thus affording men on each level the opportunity to learn before their subordinates. This had the obvious advantage of putting the higher levels of supervision in position to explain and sell the program to their groups. In addition to factory supervisors, the course was attended by time study, process, methods, and tool design engineers, accountants, production control and staff men, and other professional employees. Since 1940, approximately 2000 men and women in supervisory, technical, and professional positions have attended the full work simplification course, and an additional 2000 workers have attended condensed classes.

To insure success of a training program, it is axiomatic that proper facilities and teaching aids be provided. These include an adequate classroom, as well as furniture, motion picture camera, projection devices and accessories, charts and blackboards. Original cost for such equipment and facilities may appear great, but returns in the form of improvements and reduced cost far offset such expense if the program is properly conducted and supported. At Camden a room was set aside exclusively for work simplification training, permitting development of a work simplification center. Since use of the room was not divided, it was possible to install a projection room, maintain film supplies at the point of use, and tack up appropriate posters. Regular attendance at classes is encouraged if meetings are held at the same time and location each week. If a classroom or conference room is used which may be commandeered by executives for urgent meetings, forcing postponement of class, the result will generally be reflected in a drop in attendance. It has always been RCA practice, therefore, to schedule classes so that there is no possibility for interruption or postponement.

Although basic principles are similar in most work simplification courses, length and content of the course vary according to the type of product produced, the techniques stressed, and the supplementary material required because of plant systems or policies.

For example, the initial course at Camden consisted of 15 one-hour classes. Material was added gradually until the course included 20 two-

Factory operators are not forgotten in RCA's work simplification program. In groups of 40 to 50 they attend a two-hour lecture aimed at teaching them how to work better, and tapping their ideas for improvement. Many valuable suggestions have been submitted as a result. Material from the regular 20-session course for supervisors is adapted for this purpose. Lecture is given in air conditioned room on company time. Refreshments are served

Work Simplification

hour sessions meeting once weekly. No two successive courses were identical. Each lecture was revised to bring material up to date, injecting new anecdotes, relating principles to current events, and introducing new problems, examples, and applications of work simplification.

Introductory work simplification sessions are generally devoted to justifying methods improvement and cost reduction. This is a sound and logical procedure since, unless students believe in the necessity for factory improvement and understand its benefits, they will neither profit from class attendance nor apply the principles taught. In a peacetime, competitive economy, there can be little criticism if accent is laid upon cutting cost as the primary objective. In time of war, however, such an approach would be entirely out of step with the war program. Accordingly, emphasis was shifted during the war from the importance of work simplification as a cost reduction technique to its genuine importance in stimulating output and insuring a steady flow of war materials to the fighting fronts.

Course Material Simplified

Many work simplification courses defeat their own purpose by professionalizing the principles taught. In an attempt to lend dignity and add weight to the subject matter a textbook of highly academic approach is used, and the atmosphere surrounding meetings is definitely "classroom." This is manifested in the presentation of imposing lists of rules, complex sets of symbols, and intricate charting involving rainbow color schemes.

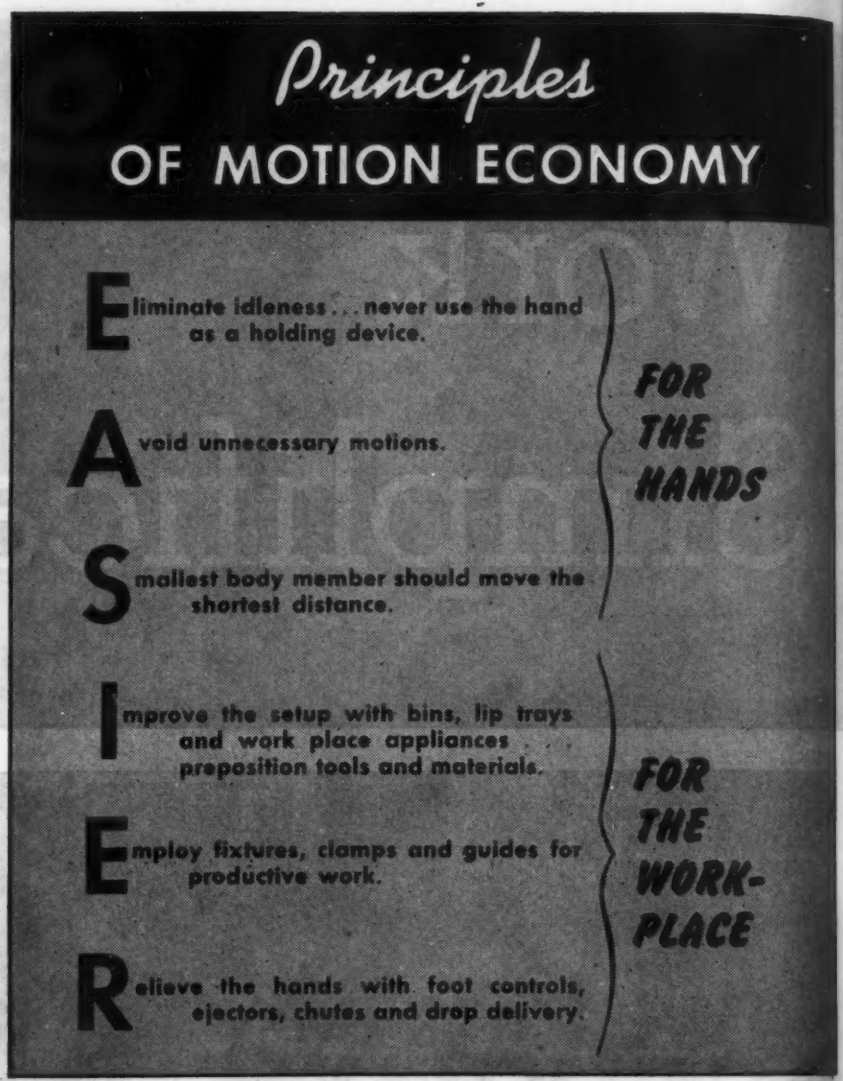
Dignity and an appreciation of the subject matter are, of course, necessary if results are to be expected from the course, but these attributes should be inherent in the material. The approach should be to present subject matter in such fashion that it is easily assimilated and applied. Attending work simplification courses should be fun, and each session should be an event looked forward to by the student.

To make classes "fun" involves more than usual effort by the instructor. Material must be worked over, reshaped, and planned for easy assimilation. Wherever possible, mnemonic devices should be created to assist learning. For example, the average foreman, six months after completing a work simplification course, will have only a hazy recollection of flow chart symbols. If letters are substituted for these symbols, as shown below, the necessary elements in a flow chart are easily remembered:

Old Symbols		*RCA Symbols*
□	Inspection	I
▽	Storage	S
o	Handling	H
○	Operation	O
o	Transportation	T

Necessary flow chart entries can be brought to mind by remembering the words "I shot" or "Is hot." Note that *handling*, an activity not generally considered as a separate element, is used in Camden flow charts. This element was necessary because the Camden plant embraces many multi-storied buildings, and materials handling is complicated by the necessity for using elevators.

A second example of the simplification of course material at RCA is the treatment of principles of motion economy. Conventional texts list 20 or more rules for the improvement of manual work. While each of these rules has possible application, the average person will neither remember a long list nor refer to notes or a text when attempting to improve operations on the factory floor. Rules are not important in themselves; it is the approach to the problems they attempt to set up that is significant. To assist in inculcating a "motion-conscious" approach, and to simplify the recall of major rules of motion economy, conventional lists were boiled down to six easily recalled principles, keyed to the word "easier" (above).


Principles
OF MOTION ECONOMY
Eliminate idleness . . . never use the hand as a holding device.
Avoid unnecessary motions.
Smallest body member should move the shortest distance.
FOR THE HANDS
Improve the setup with bins, lip trays and work place appliances preposition tools and materials.
Employ fixtures, clamps and guides for productive work.
Relieve the hands with foot controls, ejectors, chutes and drop delivery.
FOR THE WORK-PLACE

To make it easy to remember and apply motion economy principles, the customary twenty or more rules were boiled down to this list of six, keyed to the word "EASIER." These six rules, three for the hands and three for the workplace, were devised to cover the greatest number of conditions and to be applied by the greatest number of people

Note that the first three principles refer to manual motions alone. Actually, if these three principles are applied, further rules will probably be unnecessary. However, as an aid in putting the first three rules into effect, supplementary rules for the workplace are used. The first three rules cover all conditions of manual motions. Rule 1 (*Eliminate idleness . . . Never use the hand as a holding device*) pertains to idleness or absence of motion, the purpose being to eliminate inactivity of either hand. Rule 2 (*Avoid unnecessary motions*) refers to waste or quantity of movement, focusing attention on "how many?". Rule 3 (*Smallest body member should move the shortest distance*) refers to kind or quality of motion, focusing attention on "how far?".

The second set of rules (for the workplace) supplements the primary rules. Application of rule 4 (*Improve the set-up with bins, lip trays, and workplace appliances . . . pre-position tools and materials*) improves quality of motion by bringing material within easy reach, arranging tools to be handy (rule 3). Rule 5 (*Employ fixtures, clamps, and guides for productive work*) helps to eliminate absence of motion or inactivity in either hand by freeing it from being used as a holding tool, or by putting it to work (rule 1). Rule 6 (*Relieve the hands with foot controls, ejectors, chutes, and drop delivery*) reduces quantity of motions by substituting mechanical action to operate, eject, control, etc. (rule 2).

It is obvious that no set of principles, however good, will solve all problems. In developing the six principles of motion economy, the aim was to create a set of rules that would cover the greatest number of conditions and at the same time be easily remembered and applied by the greatest number of people.

In addition to such standard subjects as the economics of cost reduction, overcoming resistance to innovations, and flow, man-and-machine, and right- and left-hand charting, the RCA-Camden work simplication course includes lectures on incentive systems and time study, non-industrial work simplification applications, and improving office operations, as well as good plant housekeeping and personal salesmanship.

Stress is laid upon the latter two subjects because it is believed that they are as important in efficient plant operation as any of the standard topics. The necessity for good housekeeping, as any industrial man knows, is paramount not only because of its effect upon cost, but also because of the psychological attitude it engenders. It is easier to be efficient in an orderly atmosphere; conversely, efficient people are generally orderly. Personal salesmanship is necessary not only for the progress of the individual, but also because a knowledge of salesmanship principles can be of great benefit in helping to put new ideas into effect.

Material Presented in Palatable Form

In general, the approach is to sugar-coat or "glamorize" all the material presented. This is no reflection upon the personnel attending classes, because the roll includes some of the ablest persons in the plant, but the ideas and principles are more easily digested if put in palatable form. An illustration of this is in the presentation of the material on incentive systems. All of the words ever written about incentive systems cannot be as effective in imparting an awareness of

Toothpick capacitor assembly illustrates typical improvement made as a result of the RCA work simplification program. In old method (left) operator inserted brass clamp in jig, built up alternate layers of foil and mica, and, using hand punch, partially bent over sides of clamp to hold foil and mica. Jig was then slid to arbor press operator who completed bending of clamp. One arbor press operator serviced five or six assemblers, was idle part of time. In the proposed method (right) operator works at foot-controlled air press, builds two units at once. Foil and mica are slid into rests until assembly is made. Operator steps on pedal, causing assembly to be slid under ram of press, clamped, and automatically ejected. Arbor press operator has been eliminated. There is no passing jigs back and forth. All hand motions are productive. All motion economy principles have been applied

the meaning of incentives as actual operation under an incentive rate.

When the session on incentives is presented, no mention is made of the topic. As students enter the classroom, the instructor is nonchalantly and slowly assembling bolts and washers at a workbench in the classroom. When the class has assembled, the instructor casually asks if anyone in the class is interested in assembling bolts and washers, as a demonstration for the day's topic. The first volunteer is invited to sit at the table and "try a few." Without his knowledge, a wall clock is started and he is timed for one minute to determine the number of bolts and washers he assembles.

Generally, because there is no motivation for rapid operation, the number of assemblies made is small, and pride compels the volunteer to demand "another crack at it." On the second trial, performance is usually far superior to the fist, and the class is thereby presented with a striking illustration of the effect of motivation upon work performance.

When the first volunteer has completed his second trial, interest generally runs high in the class and several members ask for an opportunity to see what they can do. The instructor then announces that he will conduct a contest, offering awards for performance. A prepared chart, listing a schedule of awards, is placed upon the chart rack, and the contest rules are announced. To qualify for an award, the student must select his goal in number of pieces per minute. If he attains the necessary production he wins the award. If he exceeds this self-determined quota, he is not eligible for a higher award, but can only qualify for the level he has selected. If he does not attain his specified production, no award is given. Schedule of awards is as follows:

Pieces	*Award*
5	stick of gum
10	candy bar
20	two candy bars
25	½-lb. bar of chocolate
33	two ½-lb. bars of chocolate
50	1-lb. box of chocolates
60	2-lb. box of chocolates
100	4 new natural rubber tires

Presentation of the schedule usually brings laughs because all the prizes are wartime shortages. All prizes are on hand, with the exception of the tires, and are awarded immediately. Of course, 100 pieces per minute are far beyond the range of human ability; if by some accident someone had attained this production, the instructor would have had to catch the next train for California.

Spokesman and symbol of work simplification at RCA Camden plant is Simo Sam, who brings messages to foremen, reports achievement and stimulates the program. "Simo" is short for simultaneous motion. Chest emblem depicts lever and fulcrum, symbol of work improvement. Lever is a slide rule; fulcrum, the flow chart symbol for *storage*; load, a combination of the symbols for *operation* and *inspection*

As students take their turns, the level of production gradually increases, and class interest rises to a high pitch with everyone in the class rooting for each demonstrator to make his goal. Fifty pieces are usually attained by several, and someone occasionally wins a 2-lb. box of candy by doing 60 pieces.

In setting their goals, few select less than a 1-lb. box of candy because lesser prizes are not considered worth while, and few shoot for more than the 2-lb. box of candy because the goal is too high. At the end of the session, the instructor points out that generalizations concerning incentive rates may be drawn from the demonstration; if reward is too low, most persons will not be interested in extending themselves, and if expected effort is too great, few will try to meet the rate. Thus, more convincingly than hours of lecturing or reams of written material, the essential principles of incentive rates are driven home.

Teaching Aids Used; Notes Provided

In keeping with the aim to make all classes as interesting, entertaining, and informative as possible, many teaching aids are used. These include charts and graphs, prepared notes, work samples, diagnostic tests, and

films. Charts have been found to be extremely valuable since they forestall the necessity for putting material on the blackboard, saving time of the instructor and class, and also because they present a concise, easily grasped story. Notes of each lecture are prepared in advance and are distributed at the end of each session. If students are required to take their own notes, full attention cannot be given to the instructor, and there will be a lack of uniformity in the notes taken.

Wherever possible, actual work demonstrations are presented in class. This lends reality to the principles taught, because all applications are concrete and bring to the class some of the factory atmosphere in which they will be expected to apply their knowledge. The time-tested "learn-by-doing" approach is used in all possible instances, not only in the classroom but also in homework assignments. Homework is assigned for each meeting, and all students are expected to complete assignments before receiving a certificate for the course. Each technique taught is applied by every student to his own department, so that all are required to work out flow charts, man-and-machine charts, motion economy applications, etc. This not only assures a complete grasp of the techniques involved, but in many cases results in actual operating improvements. Every possible aid is given in putting suggestions into effect, and several notable improvements have been made as a result of class assignments.

Tests are given every three or four weeks both as a record of performance and as an indication of how well material has been absorbed. Where weaknesses or lack of understanding is found, a review is conducted. Tests are all of the objective variety and are simplified in form for ease and speed of completion. Humorous questions and side comments are scattered throughout the test to relieve the tenseness. Before the final examination is presented, students are given a manual condensing all the course material. All questions in the final examinations are drawn from this manual. Students are also given a set of guides for proper study habits to assist preparation for the final.

Learning Time Reduced by Using Films

One of the most important requisites for a successful work simplification course is an adequate supply of good films. Educators have long been of the opinion that films reduce learning time, not only because visual learning is rapid, but also because most persons enjoy seeing "movies." The Army's experience in accelerating training for millions of soldiers through the medium of films is further substantiation of their value.

RCA has found it advantageous to prepare its own films, although purchased films, primarily sound, are also used. There are almost 200 films in the library, sound, silent, and in color, covering each topic in the course. Prize film is one of few 16-mm. prints of Charlie Chaplin's "Modern Times" in private collections, graciously donated by Chaplin to assist in RCA's war training program.

At least two films are shown at each meeting, and in many cases three or four are used. Particularly effective are before-and-after films of shop improvements. Old-method shots are first shown, and then the film is stopped while class members offer suggestions for improvement. When satisfactory suggestions have been offered, which happens in every case, the new method is shown. Before-and-after films give excellent practice in conceiving improvements, and also build up self-confidence by showing that methods improvement is not difficult. It is important to convey the idea that an engineering degree is not necessary to make shop improvements, and that the prime requisites are proper approach and exercise of grey matter. Films are unsurpassed as a means of putting this idea across.

Good Attendance Insured

Spotty attendance is a problem in most training programs. A number of steps are taken to guarantee good attendance in the RCA work simplification classes. As outlined above, the course is made as interesting and enjoyable as possible so that everyone will want to come and would regret missing the class. Classes are scheduled on company time to prevent interference by outside personal business. Continual stress is laid upon the point that it is a privilege to attend class, and a standing rule is enforced that students will be dropped from class at the third absence. To prevent disruption of attention caused by latecomers, classes are started promptly at the scheduled time and doors are locked. Since six to eight classes are conducted per week in normal times, latecomers may attend one of the other classes. Names of absentees are submitted weekly to department managers who back the course strongly and insist upon reasons for absence from their personnel. Although these rules may seem harsh, they are not so in actual practice and have worked out so satisfactorily that percentage of attendance at each session is over 90.

Man at Bench Not Forgotten

A fertile source of ideas, frequently overlooked, is the man at the bench. Closest to the job, he is most familiar with the intimate details of the work, and, if trained and encouraged, can contribute greatly to methods improvement. When all of supervision had been trained in work simplification, attention was turned to operators as a potential source of ideas.

It was quickly apparent that the mechanics of charting, the details of time study and incentive rates, and other similar material would probably not be applied if presented to operators. This was not because of lack of ability or intelligence, but because the productive man has neither the time nor opportunity to prepare charts. However, he can think and analyze as he works, and when this thought is directed and channelized, many worthwhile contributions result.

With the aim in mind of teaching operators how to work more effectively, analyze their own jobs, and put their suggested improvements into effect, a special two-hour lecture for factory operators was written. The lecture condensed appropriate material from the full work simplification course and embraced all principles needed for improvement of factory jobs, including proper approach, motion economy principles, and method of obtaining approval.

In groups of 40 or 50, operators attended the short course on company time. Lectures were introduced by the foreman involved who explained the necessity for making improvements, and expressed his approval of the idea and interest in helping each operator put his ideas into effect. After the lectures, special notes were distributed, including copies of the principles discussed, and each operator was asked to make at least one suggestion.

Results were notably successful. Almost 2000 operators were trained, and foremen were unanimous in their approval of the idea. Many suggestions were received. Some won awards from Washington, and at least one received national publicity in a magazine.

Recognition for Foremen Provided

Providing personnel with the training and knowledge necessary to make job improvements is the easy part of a

work simplification program. It is a necessary preliminary, but is not an end in itself since the finest training is worthless unless put to use.

Obtaining results in a work simplification program cannot be left to chance. The program is doomed to failure which trains its personnel and then turns trainees loose with a pat on the back and a pep talk about "acres of diamonds in the backyard." For making improvements takes real effort in most cases, and most of us are so constituted that we work only when sufficiently motivated.

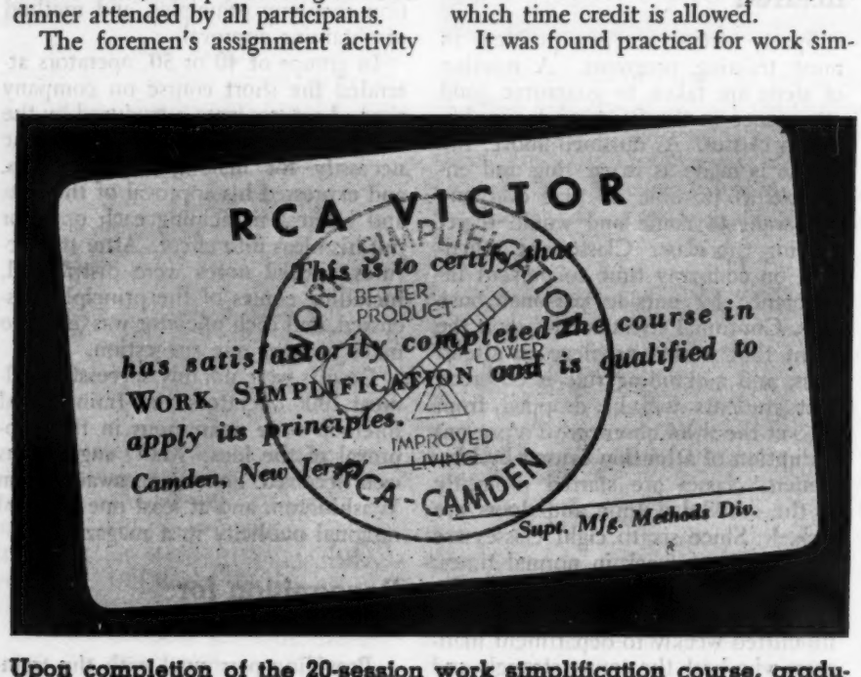
To guarantee success of a program, it is necessary to organize carefully, publicize, follow up steadily, and reward participants either psychically or economically, preferably the latter.

There are many who believe that foremen should not be rewarded for methods improvements, since cost reduction and methods activity are considered to be part of their job. Although it is recognized at RCA that the foreman is responsible for job improvement, and although it is felt that he should not receive a direct percentage award as a production operator does for suggestions, it is believed that he should receive some financial recognition. This recognition is not given to the foreman in the form of a direct award for each assignment completed. To do so would be to defeat the aim of the assignment program, whose purpose is to acknowledge and stimulate activity by foremen, and to reward, not award. Instead, savings are accumulated on an annual basis, and prizes are given at a dinner attended by all participants.

The foremen's assignment activity program is conducted in conjunction with the suggestion program for non-supervisory employees. Ideas are submitted in much the same manner as suggestions and kept on a departmental docket until completed, at which time credit is allowed.

It was found practical for work simplication coordinators assigned to each department to hold periodic meetings with foremen at which progress of ideas is checked and problems are discussed. Chief value of such meetings is that suggested improvements are continually given attention, preventing death from disinterest or inertia; in addition, group thinking frequently supplies the key to difficult problems, and competition is stimulated to suggest other improvements. Another technique found profitable is the monthly circulation of a list of open assignments, giving publicity to those active in the program and suggesting applications of improvements to other departments.

OLD METHOD—rubber sleeve and armature assembly. Operator picked up rubber sleeve, assembled it over tweezer held in other hand, allowed tension of tweezers to stretch sleeve. Then she picked up armature, inserted it through sleeve, snapped sleeve off tweezers into armature, and laid sleeve and armature assembly aside. Method was not satisfactory because one hand held tweezers continually and hence was unproductive. Every principle of motion economy was violated



Upon completion of the 20-session work simplification course, graduates are given a wallet-size certificate—if attendance has been good, homework has been completed, examinations have been passed

Labor and Material Savings Computed

When assignments have been completed and put into effect, savings are carefully computed, considering labor and material cost reductions, but not overhead expense reductions, since these reductions are intangible for the most part.

One difficulty encountered early in the program was the difference in opportunity to make improvements and accumulate large savings. In non-productive departments, opportunities

NEW METHOD—rubber sleeve and armature assembly. Foot-operated fixture permits two-at-a-time assembly. Tweezer-like prongs on fixture are opened by pedal and used to spread and hold sleeve. Drop disposal, gravity-lip bins employed. Operator picks up sleeves, assembles over prongs, picks up armatures, steps on pedal to open prongs, inserts armatures, snaps off sleeves, drop-disposes of units. Both hands now fully productive. All rules of motion economy observed

for large savings are fewer than in productive departments. Where new products are put into production, more improvements are to be expected than in old established departments. Further, a small saving in an operation performed on a part for which there are large orders may outweigh a large reduction on parts for which orders are small. Because of these variables, it was found impractical to use dollars saved as a measure of cost reduction performance.

To compensate for inequality of opportunity to accumulate savings, each section of the plant was evaluated to determine the relative possibility of methods improvement. Thirteen factors were considered, including such items as size of labor load, length of production runs, type of operation, variety of set-up, etc. The result of these evaluations is a modification factor to be applied against savings in each section. Savings multiplied by the conversion factor are used as contest points which are applied to each contestant's score.

As an illustration of how these differences in opportunity may be equalized, the savings in one case may amount to $5000, to which a conversion factor of 0.76 is applied, resulting in 3800 contest points. In another case the savings may be only $2800, but the conversion factor is 1.50, so the foreman gets 4200 points.

Program Publicized to Insure Success

Continued success of a work simplification program requires constant follow-up and continual publicity. An accounting to management of RCA program results is made on a monthly basis. This was started in the form of a single cost-reduction report which listed estimated and realized savings for each section on a monthly and year-to-date basis. Also listed were analyses of expenditures necessary to put improvements into effect as well as a summation of the most notable assignments completed in the month. This report has recently been discontinued, however, and results are reported together with suggestion program results.

Publicity is afforded the individual through the medium of monthly reports of open assignments, stories in the plant newspaper, and through a work simplification bulletin. In addition, a personal letter is sent to the foreman for each improvement, outlining the difficulties encountered and results achieved. Copies of the letter are sent to the department manager and to the personnel folder of the foreman to become a permanent part of his record. These letters are one of the most important single elements in the program and are highly prized by foremen.

To personalize and dramatize the work simplification program, a spokesman was created in the form of "Simo Sam." Handsome, burly, and breezy, Simo reported news of interest to foremen, pointed out outstanding achievement, and gave appropriate pep talks. Plywood cutouts of the program spokesman were fabricated and distributed to foremen, to stand on their desks as a constant reminder of the need for improvement. Simo instantly became a favorite throughout the plant and was regarded as almost a real person.

As a final means of publicizing the program and rewarding contestants, a work simplification foreman's manual was developed. Pocket size, the manual includes condensations of work simplification principles, essential plant operation data, and charts and tables valuable to the foreman in his day-to-day work. Manuals are of genuine leather and are prized not only because they are expensive, but also because it is a distinction to win one. They are given only to those who have successfully completed the work simplification course and who have demonstrated mastery of course principles through the successful installation of a methods improvement. A parchment dedication page in each manual is signed by plant executives to attest to performance of the individual to whom the manual is awarded.

* * *

Work simplification and methods improvement are old established programs at RCA. The fervor and excitement which characterize new programs have been mellowed as the program was accepted by the plant. Training, too, has tapered down since most of the supervisory force has already been trained.

However, at RCA, as in all other plants, it will be necessary for the duration of the war production program, as well as in the peacetime era to come, continually to improve methods. Work simplification is not merely a phrase, a course, or a program. It is a philosophy necessary for successful and competitive manufacture based on the assumption that further improvement is always possible and will be attained by those willing to expend the necessary time and effort.

Work simplification is progress—and progress is vital for success in wartime or peacetime.

TO INSURE LOW-COST PRODUCTION

6 Plan and

Case of North American Aviation, Inc.

G. F. PEARSON
Executive Assistant

S. E. SOHLER
Manufacturing Coordinator
North American Aviation, Inc.
Inglewood, Calif.

How DO WE STAND on P-51 production? This was the question management at North American Aviation, Inc., continually asked, and a full, correct answer was imperative. It was not enough simply to tell the factory manager how many ships were off the assembly line, or even to tell him how many major assembles had been completed. He already knew; he'd seen them on the floor during his morning check-up. He knew also that airplanes are spawned in detail and subassembly departments and that on-schedule production in these departments today meant scores of deadly fighters coming off the line next month.

All right, tell him how each component is progressing; give him a list of all the parts with the quantity of each scheduled and produced. How long a list is that? It's not a list, it's a book, and one that would take days to compile. Management then would have all the facts, but lacking the time to screen them, let alone act upon the hundreds of parts involved, would still ask, "How do we stand on the P-51?" Something more practical was needed.

The solution adopted, after considerable trial and error, was to *express in man-hours the physical quantity of assembly and subassembly units produced and to summarize the results into departmental and model totals.* The method was built upon existing scheduling and production control techniques; when developed to its present stage, it not only served the original purpose of giving a complete evaluation of a production program, but also became invaluable as a means of computing personnel loads and controlling shop efficiency.

Existing Systems Analyzed First

The first step was to analyze existing systems and reports to determine what kind of summarized, condensed information was immediately available. At that time, North American Aviation was already using what is termed the Weekly Comparison Schedule (Figure 1). These schedules cover all major assemblies and nearly all subassemblies on current contracts. In a report for each assembly department, the part name and number of each item is listed along with the scheduled cumulative weekly requirements in terms of ships, shown for seven weeks in the future.

This form of schedule had been found very effective because each item is individually analyzed and proper allowances are made for available storage space, elapsed assembly time, and so forth. It is especially valuable during the build-up period on new models when the problem of smoothly "filling the line" often presents difficulties which could not be satisfactorily handled by a schedule that would not permit separate treatment of individual components.

The schedules themselves are widely distributed, and the active interest of production supervisors is encouraged and assisted. Foremen and assistant foremen thus can clearly see the future requirements and work with production control and other supporting departments toward meeting the program, rather than passively waiting until production orders are handed to them on the basis of some less easily used type of schedule.

An integral part of this scheduling system from the outset has been the publication of cumulative actual production progress figures as compared with scheduled production. Each Monday morning the actual number of units produced is reported to the scheduling group on a copy of the current schedule form. These progress figures are immediately typed on the face of the original master copy, and

Control Production

When a department lags behind, visual inspection will not reveal how many man-hours are needed to put it back on schedule—but a report of the type used at North American gives an immediate answer

Weekly Comparison Schedule North American Aviation, Inc.		Range	Date 11-1-44 Replaces 10-8-44 Contract AA-1001			Department Name: Control Surfaces Model P-51 Page 1 of 1					Dept. No. 95
Part Name	Part No.		Date	11-12	11-19	11-26	12-3	12-10	12-17	12-24	12-31
1 Aileron Complete	158-16001&-1	20	Sch Act	1000 1000							
2 Aileron Complete	158-16001&-1		Sch Act	1085 1084	1200 1201	1315 1314	1435	1555	1675	1795	1915
3 Spares			Sch Act	283 285	303 310	323 324	343	363	385	407	429
4 S.O. 1538	135-16001&-1		Sch Act	15 10	20 27	25 27	30	35	40C		
5 Flaps	158-14005&-1	25	Sch Act	1000 1000							
6 Flaps	158-14005&-1		Sch Act	1075 1070	1190 1183	1305 1305	1425	1545	1665	1785	1905
7 Spares	158-14005&01		Sch Act	277 277	298 298	318 318	338	358	380	402	424
8 Empennage Complete	158-16031&-12	20	Sch Act	1000 1000							
9 Empennage Complete	158-16031&-12		Sch Act	1050 1052	1165 1167	1280 1281	1400	1520	1640	1760	1880
10 Spares	158-16031&-12		Sch Act	280 281	300 299	320 317	340	360	382	404	426
11 Horizontal Stabilizers	158-25001&-100	20	Sch Act	1000 1000							
12 Horizontal Stabilizers	158-25001&-100		Sch Act	1063 1060	1178 1178	1293 1294	1413	1533	1653	1773	1893
13 Spares	158-25001&-100		Sch Act	275 276	295 276	315 315	335	355	377	399	421
14 S.O. 2136	135-25001&-100		Sch Act	10 10	15 15	20 20	25	30	35	40C	
15 Vertical Stabilizers	158-25002&-100	20	Sch Act	1000 1000							
16 Vertical Stabilizers	158-25002&-100		Sch Act	1070 1075	1185 1185	1300	1420	1540	1660	1780	1900
17 Spares	158-25002&-100		Sch Act	275 278	295 298	315 318	335	355	377	399	421

Figure 1. Foundation of the North American method of controlling production is the weekly comparison schedule which lists assemblies and subassemblies and shows week-end cumulative requirements for weeks to come. Actual production of each item is reported on the same form each Monday morning

new copies are made and distributed to those concerned before noon of the same day. This comparison report requires as much as 90 pages in total, and for that reason is not suitable for management's use in evaluating over-all project progress. Below the management level, however, such a report serves the needs of production and supporting department personnel who are concerned with a specific department and individual assemblies built in the department. This comparison report gives the basic detail material which somehow had to be summarized to obtain that elusive objective, "the over-all picture."

Without any additional information it was possible to add up the number of units ahead or behind schedule for each item, and summarize these figures for a department, labeling the total as the "number of assemblies ahead or behind schedule." Presumably these department totals could be summarized further into a "total assemblies ahead or behind schedule" for the project, thereby giving a "condensed" answer. However, such a summary was very unreliable, even within one

department, because some of the assemblies were larger or more complex than others and therefore required considerably more man-hours per unit to produce. Taken plant-wise, this distortion made the figures almost totally unusable on account of the ever-present possibility that 10 hinge brackets ahead of schedule would be balanced against 10 wing panels behind schedule whenever a plant total new "assemblies ahead or behind schedule" was compiled.

As a result, any summary of this type could be considered only as a relatively incomplete departmental trouble signal and still left management the problem of evaluating overall status from the detailed information on the face of the comparison report. It became apparent, after a few trials, that mere summarizing of existing information was not adequate to solve the problem. A denominator that would reduce unlike assembly units to a common measure was needed.

The second step, then, was to devise some means of weighting or evaluating available information without appreciably interfering with existing systems and without creating wasteful duplication. The use of man-hour figures for this purpose was a natural choice, because any behind-schedule condition, regardless of whether it is caused by a lack of tools, parts, or material, still requires the expenditure of man-hours to regain the schedule at such time as the restraining obstacle is removed. Also, under wartime conditions of chronic manpower shortage, the supply and demand of man-hours had become one of the most important and closely watched phases of manufacturing.

Clerical Problem a Real Obstacle

At first glance it appeared that the problem involved only the application of a unit-hours figure for each item to the accumulative status relative to schedule as reported in the current comparison report. This approach was tried out for several weeks in a few departments, and, although the significance of the statistics obtained therefrom was very encouraging, the clerical problem of handling the necessary computations presented a real obstacle. At first the unit-hours figures were maintained on a separate list and had to be correlated with the comparison report items each week after that report had been issued. This arrangement was inconvenient and subject to several errors, especially when the unit hours for a spare or service order assembly differed from

Visible index files contain schedule planning sheets (see Figure 2, next page) from which the weekly comparison schedule (Figure 1, facing page) is prepared. Sheets are grouped by number and department, with department totals shown on a colored dividing card

the corresponding production assembly. As a result, the computations were sometimes delayed until the middle of the week. Yet to be of maximum use these figures must be made available to management a very short time after the detail status has been reported on the job. It became imperative, therefore, to devise a quicker and more efficient technique for the computations required.

At this point the investigation of various techniques for efficiently combining schedule, status, and unit-hours information suggested an additional possibility that should be considered as an integral part of any new system proposed. If realistic unit-hours figures, rather than simply crude weighting factors, were obtained for each item, the departmental labor load could be calculated much more accurately than ever before.

As the computation of both the man-hours ahead and behind schedule and the labor load were based on the weekly schedule for each item, the existing work sheet being used by the schedulers at that time was expanded and redesigned to take care of the new requirements. The result was the composite 8½x11 Schedule Planning Sheet (Figure 2). As before, a separate sheet for each assembly or subassembly unit still provided for all necessary scheduling data. The new information was inserted in such a way that normal scheduling operations were not interfered with. For example, the scheduling typist still typed schedules directly from this planning sheet to the master without requiring that the figures first be penciled on a blank form.

The added horizontal spaces provided for three things besides the schedule figure:

1. Actual cumulative production progress as reported.

2. Calculated man-hours load per week.

3. Calculated man-hours ahead or behind schedule corresponding to the actual progress posting described.

In addition, a space was provided for the unit-hours figures which were to be currently used in load and status calculations. As a unit-hours space was provided for each section of the card, differing unit-hours for spares or service orders were clearly shown opposite the corresponding spare or service order schedule. Although the first form of this type was similar to the form now in present use, some trial-and-error experience was required to iron out a few minor "bugs."

With an efficient functional work sheet successfully designed and in operation, it was found that the establishment and maintenance of a realistic unit-hours figure for each item required more than passing thought. The first simple solution appeared to be the use of the current *actual* unit hours.

Correct Unit-Hours Data an Essential

However, since it was now the intention to use this same system as the source of basic data for labor loads and personnel budgets, the use of actual unit-hours was unsatisfactory. It would have resulted in a budget based on current efficiency, saying, in effect, that whatever existed would be allowed. Naturally such an assumption was completely unacceptable to any progressive manufacturing organization. It was therefore agreed that the unit-hours as applied to the computation sheets should always be lower than the current actual unit cost for the item. But the question then arose, how much lower should the unit-hour be?

At the time this problem came up, the P-51 was a comparatively new model and had not been completely covered by time study standards. As a result, departmental "goals" in terms of hours per ship were estab-

lished on a more-or-less estimated basis by division management which, through familiarity with manufacturing operations, was able to judge the probable efficiencies to be expected in various departments. The departmental goals thus established by management were then broken down in two different ways into hours for each unit built in the department. Where actual hours for individual assembly units were available, the proportion of actual unit-hours to actual department total hours per ship was applied to the departmental goal. Where the time-keeping system did not provide hours per scheduled unit, the foreman of the department was asked to distribute the allowed department hours according to his best judgment.

However, these goals could be reestablished only infrequently for each department with the result that each new goal was considerably below the previous one, and, for a period of time, well below current performance.

As a result it was necessary to use a considerable amount of common sense in establishing the labor loading unit-hours figure somewhere below the current actual unit-hours, always keeping the established goal in mind. But the hours ahead and behind schedule figures provided exactly the guide or danger signal needed to make sure that this continual reduction of the allowed personnel did not go too fast nor too far. In other words, the continual reduction of the unit-hours for the labor loading purposes gave the production departments a guide as to the number of workers that should be used to insure a steady reduction of actual unit cost; yet, if the production status in terms of man-hours behind schedule started to rise over a period of weeks, it was immediately apparent that any further limitation of the working force might jeopardize schedules, and should be stopped.

One Result: Good Labor Utilization

As soon as an on-schedule condition was regained, reductions in the labor loading unit-hours figures could be safely resumed. The important point was that, at a time when production schedules were accelerating in the face of increasing shortage of manpower, it was possible to derive much of the labor utilization benefit of a standard program before time study standards were available. All that was required was someone with sufficient authority to establish reasonable goals as a guide for reduction of the unit-hours used in the calculations and a way of computing the position of the department in terms of effort.

Later on, when standards were established through the use of time studies, the determination of unit-hours figures naturally became more accurate and much less arbitrary. When these standards were available, it was decided that unit-hours would be established somewhere above the standard but below current actual, the distance below the current actual being a function of how far the current actual was from the anticipated standard attainment at the time. In other words, for an item whose actual current unit-hours are running far above expected standard attainment, the unit-hours used for labor loading is appreciably below the current actual on the assumption that such a badly off-standard condition must be alleviated in the immediate future.

On the other hand, if an item's

SCHEDULE PLANNING SHEET

| | | |

actual unit-hours are running close to the expected standard attainment, the labor loading unit-hours are set only slightly below the current actual, on the assumption that the last few steps of standard attainment are obtained only gradually. In those few instances where actual unit-hours run below standard, the labor loading unit-hours are always set just slightly below current actual on the assumption that in such a case the standard is an error rather than the actual cost, and that if the standard were reset properly it would be slightly below current actual. After being established, these labor loading unit-hours are periodically reviewed and adjusted as the actual performance improves, which can be done for a comparatively small expenditure of effort.

With a schedule for individual items, man-hours for each item, and a planning sheet designed to eliminate the need for any additional cards or work sheets, the rest is simply a mechanical extension of the figures to provide the desired answers. Before any actual progress figures are posted, the labor load calculations are extended into future weeks. These figures are merely the difference between accumulative schedules, times the unit-hours figure for the item. A total for the item is entered at the bottom of the planning sheet and then all items are summarized to give the departmental total.

Here is the figure that tells the scheduler when capacity is available to build additional service orders, and which permits management to balance manpower with loading requirements before overmanned or undermanned conditions create a problem, rather than after.

Man-Hours Converted to Employees

Of course, several calculations and adjustments must be applied to a weekly man-hours load figure before a final report in terms of departmental manpower requirements can be presented. These consist of converting hours to employees by dividing by the scheduled work week, after correcting for the expected percentage of absenteeism and making allowances for rework, overhead, and the department's current status relative to schedule. This last is not possible with many personnel budgeting techniques but is highly desirable, since additional employees should be allowed to correct a behind-schedule condition over and above those allowed to meet the current scheduled load. The determination of the magnitude of this allowance is greatly simplified by the use of the man-hours ahead and behind schedule status figures described below. Since labor loads are calculated on the same sheet used for scheduling, all schedule changes, new service orders, or transfers from one department to another are noted, and the load calculations corrected.

Although these labor loads need to be recalculated only as changes are required, production status in man-hours is computed regularly once a week to provide summarized data for management and supervision. As the comparison schedule reports come in each Monday morning, the actual figures for each item are posted in the space provided on the corresponding planning sheet. The same progress reports are immediately passed on to the scheduling group where the status information is typed on the original schedule masters, and new copies showing the progress information are run, assembled, and distributed.

The posted planning sheets, which are filed in hinged trays, are simultaneously taken by a calculator operator for the determination of the man-hours ahead or behind schedule on each item. This figure is merely the difference between the cumulative schedule and cumulative actual ships' worth of the item multiplied by the unit-hours shown on the planning sheet. The net status of the item is posted at the bottom of the planning sheet (in green if ahead, in red if behind), and then the total net status for the department is summarized on the department total card. A total for the model, being the net summary of all the department totals, is calculated in a final operation. In actual practice it has been found that one competent girl can complete departmental summaries on a contract involving approximately 1000 planning sheets by Monday afternoon.

Answer to Big Question Provided

So much for the mechanics of obtaining the hours ahead or behind schedule figures originally sought after. The remaining problems are those of presentation and evaluation in order to give management an adequately condensed, yet undistorted and complete, answer to the question, "How do we stand on the P-51?"

Handing management one total figure representing man-hours ahead or behind schedule once each week would provide a "condensed" answer, but too many significant departmental variations were obscured for efficient operating control. Therefore, it was decided to use departmental summaries, so that action through line organization responsibility could be taken where indicated (Weekly Departmental Hours Status, Figure 3).

It was apparent, however, that merely showing the number of man-hours ahead or behind schedule for each department, although valuable for reference and as an indication of the absolute magnitude of departmental condition, still left some evaluation work if a comparison of one department with another was desired. This was because a department that was 1000 man-hours behind schedule, and had a weekly load of 1000 man-hours per week, was in a much more critical condition than a larger department which was a similar 1000 man-hours behind schedule but which had a weekly load of 10,000 man-

10	15	20	25	30	35	40
0	10	27	27			
115	115	115	115	115	115	115
-230	-115	+161	+46			
264	283	303	323	343	363	383
270	285	310	324			
361	361	380	380	380	380	418
+114	+38	+133	+19			
1002	1085	1200	1315	1435	1555	1673
1002	1084	1201	1314			
-	1577	2185	2185	2280	2280	2280
0	-19	+19	-19			
983	1000					
983	1000					
-2090	323					
0	0					
11-5	11-12	11-19	11-26	12-3	12-10	12-17
2564	2376	2680	2680	2775	2775	2813
-116	-96	+213	+46			

Figure 2. Schedule planning sheets are used not only for laying out the schedule requirements of assemblies, but also as the worksheets for calculating weekly load and status in terms of man-hours **(see weekly comparison schedule on page 130)**

WEEKLY DEPARTMENTAL HOURS STATUS

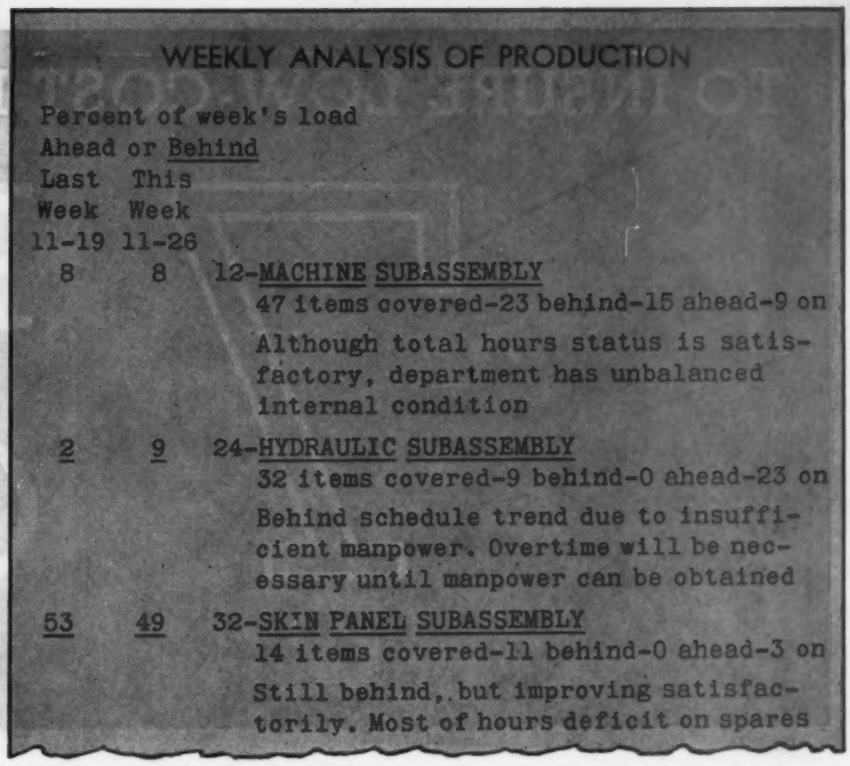
Department	Percent of Dept. Covered							
		Rate	110	110	115	115	120	120	120
		Date	11-5	11-12	11-19	11-26	12-3	12-10	12-17
32	100	Load	7050	7050	7350	7350	7700	7700	7700
		Hours Ahead	110	540	80				
		Hours Behind	3780	4090	3950	3600			
		Status (net)	3670	3550	3870	3600			
33	100	Load	4150	4150	4350	4350	4550	4550	4550
		Hours Ahead	660	510	250				
		Hours Behind				100			
		Status (net)	660	510	250	100			
44	100	Load	3750	3750	3900	3900	4100	4100	4100
		Hours Ahead	0	0	0	0			
		Hours Behind							
		Status (net)	0	0	0	0			
Total for Sub-Assembly Departments		Load	127000	127000	133000	133000	139000	139000	139000
		Hours Ahead	12700	14180	13380	10040			
		Hours Behind	49650	44170	41180	39930			
		Status (net)	36950	29990	27800	29890			
8	100	Load	2500	2500	2600	2600	2700	2700	2700
		Hours Ahead	1170	1060	940	1020			
		Hours Behind	630	240	370	90			
		Status (net)	540	820	570	930			
12	100	Load	6900	6900	7200	7200	7550	7550	7550
		Hours Ahead	420	710	630	600			
		Hours Behind	2000	1810	1180	1190			
		Status (net)	1580	1100	550	590			
22	100	Load	4900	4900	5100	5100	5850	5850	5850
		Hours Ahead	520	530	650	580			
		Hours Behind	400	210	110	90			
		Status (net)	120	320	540	490			
24	100	Load	10350	10350	10800	10800	11300	11300	11300
		Hours Ahead	300	330	240	390			
		Hours Behind	690		20	1380			
		Status (net)	390	330	220	990			
82	100	Load	1850	1850	1950	1950	2050	2050	2050
		Hours Ahead	40	150	370	500			
		Hours Behind	150	560	370	430			
		Status (net)	110	410	0	70			

Figure 3. "Management by exception," as practiced at North American Aviation. Departmental summaries make it possible to locate offending departments and take necessary action. Individual components causing trouble may be found in weekly comparison schedule or schedule planning sheets

hours per week. A form of presentation was therefore devised which compensated for the variation of the size of departments. Weekly status figures are expressed in "percent of week's load" ahead or behind schedule. In this way the true magnitude of a department's behind schedule condition as compared to its production capacity is indicated in an easily grasped form.

Although it was felt that these departmental summaries were all the pure statistics that should be reported consistently to management, there was contained on the computed planning sheets a great deal of important information of which management should be made aware.

For example, a department's net percentage of a week's work might show only an insignificant variation ahead or behind, thereby apparently indicating a desirable condition. Yet that status could have been the result of half the items being far ahead of schedule and the other half far behind schedule. Therefore, comments on undesirable conditions such as this are included along with the departmental summaries in a Weekly Analysis of Production (Figure 4) specifically designed for management.



WEEKLY ANALYSIS OF PRODUCTION

Percent of week's load Ahead or Behind			
Last Week 11-19	This Week 11-26		
8	8	12-MACHINE SUBASSEMBLY	47 items covered-23 behind-15 ahead-9 on Although total hours status is satisfactory, department has unbalanced internal condition
2	9	24-HYDRAULIC SUBASSEMBLY	32 items covered-9 behind-0 ahead-23 on Behind schedule trend due to insufficient manpower. Overtime will be necessary until manpower can be obtained
53	49	32-SKIN PANEL SUBASSEMBLY	14 items covered-11 behind-0 ahead-3 on Still behind, but improving satisfactorily. Most of hours deficit on spares

Figure 4. Sample page from weekly analysis of production, which shows departmental status in percent of week's load ahead or behind

As a result, management is given not only summary statistics which are really "significant," but also a complete analysis of supporting statistics. In its final form this report actually provides even more of an answer than was originally intended, because the computations devised provide a basis for noting and analyzing trends. As a result, it is possible to state not only where the plant stands, but also to indicate where it is heading.

Limitations and Advantages Listed

Before summarizing the advantages of this system, a brief discussion of its limitations is in order. As the system is based on an individual schedule and progress report for each item, it is not economical to attempt this type of coverage on every part of the airplane. However, by including every assembly in the airplane, approximately 80 percent of the direct labor involved is covered. Any attempt at extension of individual item coverage into the remaining 20 percent representing the mass of detail parts, encounters the law of diminishing returns, because the slight additional control secured is not worth the considerable additional effort involved in obtaining the coverage.

It must not be assumed, however, that these details can be ignored, as far as schedules or progress reporting is concerned. Some form of code type scheduling system is a minimum requirement so that in-work and completion dates for individual orders can be determined. Reporting on this type of department includes a weekly status, with the number of work orders in work, number behind schedule, and the number of work orders held past the in-work date, broken down according to the various reasons for their being held.

For the purposes of determining over-all status of detail fabrication, it is possible to treat all parts of a specific type (sheet metal or machined) as homogeneous units without encountering the gross errors which attend the application of this assumption to assemblies. Analysis of such information in detail departments has been found to be adequate for that portion of manufacturing operations.

The advantages of the man-hours technique may be summarized thus:

1. It is based on detail data supplied by a schedule and reporting system justified on its own merits.

2. It utilizes unit-hours information which is also essential for labor loading calculations. In fact, the maintenance of the unit-hours information for each item would be justified as a means of obtaining labor loading information alone.

3. Using a slight expenditure of effort over and above that already justified in the scheduling and loading system, management is provided with easily grasped summary figures along with a fully qualified analysis of the supporting statistics.

4. It fits the "management by exception" principle by showing: (a) How the over-all plan is progressing; (b) what departments are causing the variations; and (c) what specific assemblies are causing the trouble. Management can delve into the level of detail indicated by the magnitude of the deviation from schedule.

5. By showing ahead of as well as behind schedule conditions, a means of preventing excessive storage problems is provided, thereby insuring production progress on a broad front.

6. All the loading and status operations for two models, including maintenance of unit-hours figures (not including the setting of standards) requires the part time of only three employees.

All of which adds up to the fact that when someone wants to know how the P-51 is doing, short, undistorted, yet complete reports are available; and with these controls in operation the answer "on the beam" clicks off with satisfying regularity.

TO INSURE LOW-COST PRODUCTION

7 Make t Good

Case of Woodward Governor Company

W. A. RING

Secretary and Plant Manager
Woodward Governor Company
Rockford, Ill.

PHYSICAL PLANT and equipment combine with an enlightened brand of industrial relations to insure something approaching ideal working conditions at Woodward Governor Company, Rockford, Ill. The 1600 men and women employed in the modern factory and offices of that company spend their days in about as pleasant a place as it is possible for industry to provide and as a result, in the opinion of Woodward management, they turn out more work, and a better quality of work, at lower unit cost.

That assurance—plus the certainty that what this company has done, other companies can do—is implicit in what is set down in this case study.

"Members," Not Employees

Before embarking upon a detailed description of the Woodward plant and a discussion of its industrial relations program, it should perhaps be explained that the company does not look upon its people as employees. Instead, all who work in this company are *members*—whether they get dividends or wages, whether they are part-owners or not.

The company describes itself as "a business organization, including stockholders, machinists, executives, engineers, and others who have freely associated themselves to do collectively what it would be impossible to do individually." It adds: "When we speak of the 'Company' we therefore refer to *all individuals who collectively form the company.*"

In other words, regardless of whether a man sweeps the floor, runs a lathe, signs the checks, or carries the title of president, he is a member of the over-all enterprise. As such, he has an individual responsibility not only to himself but also to all the other members of the concern.

This view is something like a two-edged sword, because it makes the individual realize that not only has he a responsibility toward the others but also that they have certain obligations to him. He perceives, for example, that slacking on the job or poor workmanship by one of his fellow-workers hurts *all* the members of the concern.

Plant and Equipment

The Woodward factory and office buildings occupy a small part of a 25-acre tract about four miles from the center of Rockford. The main building is two stories high at the front and center where the offices are located, and one story elsewhere, with a basement throughout. It has about 125,000 square feet of floor space. One other building with about 20,000 square feet stands near the rear of the main structure.

Architectural beauty of the main building's exterior is achieved largely through the balance and simplicity of its lines. The appearance is enhanced by the spaciousness of the grounds, and by an ornamental iron fence, some posts, and iron gates which border the front line of the property.

Incorporated within the main building is an earlier concrete structure once used as a car barn, but no longer recognizable as such. The new structure is reinforced concrete and steel. The roof is precast concrete tile with

Temporarily crowded but always clean, well-illuminated, air conditioned, and cheerful, describes the general condition of the main production areas at the Woodward Governor Company's plant in Rockford. Terrazzo floors, tiled walls and columns, recessed lighting, music and news transmitted through loudspeakers in the ceiling, and emphasis on morale are some of the features that make this plant a good place to work

the Plant a Place to Work

2 inches of insulation, and a tar and gravel covering. It is supported on steel columns on 45x56-ft. centers.

Fluorescent Lighting

Behind the reception room at the front entrance is the main office, used by most of the executives and engineers. Fluorescent lights, in fixtures recessed into the ceiling, are spaced on 2x7-ft. centers, providing 140 foot-candles of light intensity over the drawing boards which occupy one end of the room, and 60 foot-candles elsewhere. Shadows are almost entirely absent, and there is complete freedom from glare. Such excellent illumination not only helps the members do more and better work, it also reduces fatigue.

The floor covering in the main office and in the departmental and private offices adjoining is rubber tile.

Stepping through a hallway or through the shop superintendent's office, just behind the main office, one comes to the main production area. Here the terrazzo floors are kept as spotless as a good housewife's kitchen. Alundum is mixed with the terrazzo as insurance against slipping. Overhead are fluorescent lights, spaced on 7x6-ft. centers, to give a minimum of 50 foot-candles throughout the large room, and as high as 150 foot-candles wherever needed.

Walls in this area are ceramic tile and the columns are covered with the same material, all in color. The ceiling is white, upper parts of the walls and columns are cream, and the lower parts are a semi-gloss green. Machinery is light blue. Cabinets and toolboxes are mostly dark green; a few are the light oak color of natural wood. These colors make the room good-looking, cheerful.

Loudspeaker System

Music is played in the morning for a 15-min. period once an hour. In the afternoon, the 15-min. periods are twice an hour. Most of the music is from recordings. Sometimes it includes a radio musical program.

On special occasions the loudspeakers may bring into the shop and offices a talk by the president of the company, or some other address. Official company announcements also are made to the members by way of the loudspeaker system.

The same loudspeakers are used for paging. This is done even when music is being played, but without stopping the music. The voice is carried at a little higher pitch than the music, and merely lasts long enough to say, for example: "Mr. Jones, call 454." Such interruptions are never frequent enough to spoil the music.

Musical programs from recordings and radio are played on the loudspeaker system at regular intervals. Control room equipment permits messages on the same system without interrupting the music. Pick-up equipment also is available in the plant's big auditorium

Air Conditioning

Members enjoy the year-around comfort of air conditioning. Except at the front entrance, the entire main building is windowless.

Five blower units circulate air for the main building and the nearby annex. The combined amount is about 213,000 cubic feet per minute. In the annex about 50 percent of this is new air. In the main building the new air content is about 20 percent. All the air is cleaned and adjusted to the proper humidity and temperature before it passes through the blowers.

Fresh air blown into the old building is not conditioned because the relatively large quantities required to offset the exhaust from plating, polishing, painting, and cleaning operations would make the cost of cooling prohibitively high, and because the quantity is sufficient to furnish a relatively high velocity, making the lack of artificially cooled air less noticeable.

Heating and Cooling

In the main building, all the air is heated or cooled, humidified or dehumidified, and filtered through self-cleaning electric precipitation-type filters. When heat is needed it is supplied by steam coils in the fresh air pipes. Cooling is done with well water at about 54 degrees. Humidity is controlled by a system utilizing lithium chloride solution in a continuously regenerated cycle. The filtering system is capable of removing even smoke particles and some airborne bacteria which would be unimpeded by ordinary filters.

Heat losses in the main building are so low that were it not necessary in winter to heat the 20 percent fresh content of air, no heat would be required for the office, auditorium, and basement until outside temperature fell to 5 degrees below zero, and none would be required for the machine shop until the outside temperature reached 45 below. This may be still more surprising when it is explained that nowhere in the plant are there any production processes of a type

commonly known as large radiators of heat.

For heating new air, steam is generated by two 125-hp. oil-burning boilers equipped with automatic controls. At 10-lb. pressure, this steam is adequate also for process needs such as plating and cleaning, and for heating water for lavatories, showers, and incidental purposes.

Parking Area

At the time the plant was designed, it was intended to use the basement as a garage for members' cars, and as a recreational area. With the large influx of war orders, however, it was necessary to use more of the projected garage and recreational area for productive operations.

Accordingly, a large parking lot was provided outdoors, near one of the side gates, and most members use this entrance when they come to work.

Cafeteria

A cafeteria of ample size, pleasantly illuminated and well equipped, also occupies a large room in the basement. This cafeteria operates practically around the clock.

In the adjoining kitchen, electric stoves are used for cooking, and as much other equipment as possible is electrically powered. A large room-temperature storage closet for supplies, a refrigerator room, and a cold-freeze room open into the kitchen.

Not far from the cafeteria are the time clock area and what remains of the recreation area. The latter is now confined to a few tables equipped with magazines, checkerboards, and other games, and to canteens for dispensing candy and soft drinks.

A photographic studio, the plant publication office, and a one-room training area are also located in the basement.

Air-Dried Lockers

Nearby are the locker, shower, and toilet rooms, walled with ceramic tile, and with terrazzo floors. Lockers are mounted on curbs over trenches and the air conditioning is so arranged that fresh air entering the room is drawn into the lockers and exhausted through them into the trenches. This keeps all stored clothing dry, and keeps the room free from disagreeable locker-room odors.

Although the recreation area is not nearly as large as it was originally intended to be, there is still room for tables with magazines, checkerboards, and other games. Candy and soft drink canteens are close by. Here members may relax and smoke during their rest periods

Health-Lamp Bathing

Next door to the shower room is a health-lamp room. Here a number of ultra-violet lamps line both sides of a passageway along which members, coming nude from the showers, may walk. A moving hand rail along the passageway guides the light-bathers, wearing dark goggles, and at the same time regulates their speed in passing through the room to insure proper exposure—approximately half a minute. Health records show a perceptible decrease in the incidence of common colds during the winter.

A big bowl of vitamin capsules from which members help themselves also helps to maintain their health.

Auditorium Equipment

Occupying most of the second floor is the large auditorium, entered either by stairs from the main entrance or by stairs from the main floor shop and offices. Comfortable chairs in row-units seat more than 500 persons in the auditorium, or may be pushed into adjoining rooms so that the auditorium may be used for dancing.

Filament lights are used in the auditorium because the lights have to be dimmed when motion pictures are shown or when performances are given on a large stage.

Equipment in the projection booth includes a 16-mm. sound projector for movies, a 35-mm. strip-slide projector, and a glass slide projector. Also installed here is the frequency modulation radio reception equipment which is tied into the switchboard in the public address system's control room in the basement.

The stage is equipped with a large screen for motion pictures and slides and a microphone which can be connected either to loudspeakers in the auditorium alone or to the whole plant's public address system. Also there is a horn-type pick-up microphone for receiving and relaying voices from the audience area, and a piano of a quality suitable for concert artists, with a Solovox attachment.

All programs produced in the auditorium can be broadcast not only in any or all parts of the plant, but also can be recorded in the control room.

Other Facilities

On the main floor, other rooms include a laboratory in the employment office where all prospective members

Executives, office workers, and plant workers get better acquainted as they dine and chat in the company cafeteria

are given aptitude tests. Unusual emphasis is given to mechanical devices for testing aptitudes, such as manual dexterity. (FACTORY, "Tests to Select and Place People," December, 1943.)

Here also is the shop hospital, completely equipped for emergency and routine care of members. Besides the usual first aid equipment, there are a short wave therapeutic machine and X-ray apparatus.

On a mezzanine, with large glass windows overlooking the main floor shop, is the production control office with high illumination to aid accuracy and save eyestrain in dealing with charts, figures, and control boards.

The applied philosophy of management at Woodward, in the relations between those members who are a part of management and those who are not, is one of the strongest reasons men call this a good place to work.

This philosophy is explained to accepted job applicants at the time they are inducted. It is carefully detailed in an eight-page introduction manual in which the foreword strikes the keynote:

"Each individual in the company is in general terms a businessman and a manufacturer. Each individual has a part of the total task to perform. . . .

"Each individual must contribute his proportionate share if the business is to be a successful and enduring one. He should have the requisite qualifications and an honest and sincere desire to contribute wholeheartedly to the success of the company.

"The requisite qualifications include not only the actual ability to handle the assigned job, but the physical fitness, moral stability, and mental flexibility necessary for the harmonious and successful operation of a modern business.

"The company wishes to assure itself that you, as a prospective member, have the qualifications necessary to enable you to contribute your proportionate share to this organization. We believe you should assure yourself that this company has the qualifications you consider essential to make it an organization with which you wish to associate."

Wage Policy

On the subject of wages, the manual advises the applicant that the company's past history has "proven it to be capable of sustaining moderate wages and dividends with fair consistency year after year. . . The wages, if prudently managed and consistently maintained, should enable them (the members) to become moderately independent in time, and thus bring security for declining years. Wages are purposely determined on a gradually ascending level in order that they may be more consistently maintained and so that years of service produce increasing reward."

How the view that all workers are "members in a collective effort" ties in with the determination of wages, is shown to the applicant in supplementary paragraphs:

"Wages constitute a controversial subject to which a solution satisfactory to everybody will probably never be found. However, there are certain fundamental factors that must be considered. The first factor is the total amount of money available with which to pay wages . . . The second factor is the matter of determining what proportion of the available money each individual should receive.

"This is probably the most controversial problem and hardest to solve because it involves the natural characteristic of individuals to feel that their value is always underestimated.

"We require exceptional quality of workmanship. Therefore, you will need to gage your speed of production to that level at which you can produce perfect quality. As you become more expert at the particular job, your speed of production—in fact, your general efficiency—should increase until you reach the limit at which you can maintain your part of the total effort and still maintain the necessary quality.

"We use no means devised to force a man to produce. In this company, you are on your own, and it is expected that you will constantly be alert to more efficient methods (through elimination of waste motion, better tooling, etc.) that will help you to increase your contribution.

"The company recognizes superior

workmanship in the determination of a man's relative value to the organization which, in turn, determines his proportionate share of the total wages available. Although human fallacies naturally enter into any wage determination, nevertheless a sincere desire to be fair is a characteristic of this company, and in all probability any temporary inequalities in the wage rate of any individual will, over a period of years, average out so that he will receive his proportionate share."

Self-Respect Ideal

Among the members a feeling of self-respect is fostered by the company and is fortified by the respect shown by members to one another. This stems also from the company's own philosophy.

The company sincerely wants its members to conduct themselves in such manner that they will not only receive the respect of others, but will also deserve it. As such conduct comes both from the inward feeling and the outward appearance of each individual, the company has succeeded in instilling the self-respect idea until it has become adopted by the members as their own.

Typical is the company's statement to new members, that "the company believes that there is a high correlation between cleanliness and efficiency; consequently, the fellow who is clean and neat physically and in his dress, and who works in clean, well-lighted surroundings will not only do a better job but will have more respect for himself and the work he turns out. There is dignity in any worth-while work, and certainly the man who can use his hands and head, as a skilled machinist, is doing a dignified work. Too often in the past, the so-called 'white-collar' worker has been put into a different bracket from the shop worker. Young people have labored under the delusion that to be a success they had to become white-collar workers, when in reality the shop worker may be much more valuable to society. It is the earnest desire of the company to properly evaluate the job, and in asking each individual to report for work clean shaven and neatly dressed, it is merely trying to create self-respect and efficiency."

Combine this comment about shaving, and about the dignity of the shop worker as compared to the white-collar worker, with the previous statement that "we use no means devised to force a man to produce. . . . In this company, you are on your own . ." and you may be able to see how the atmosphere of personal dignity leads to and is combined with self-imposed responsibility.

Personalized Uniforms

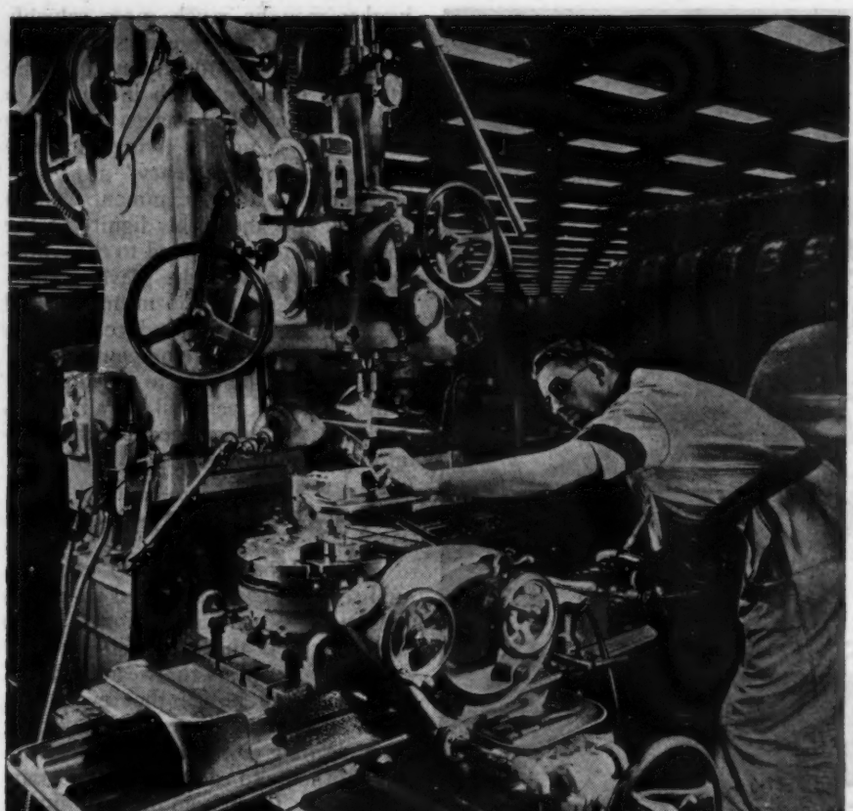
Walk through the shop and you will see that every man and woman is wearing a Woodward uniform. Take a closer look and you will see that each uniform bears the wearer's name. You will also notice that every uniform is clean. All members pay their own cleaning costs—but that does not cause them to defer any necessary cleaning. They keep their uniforms clean because they have personal pride and because the company encourages that pride.

Because encouraged cleanliness leads to a pride in self which subconsciously develops a supplementary pride in workmanship, there is a double set of mutual benefits. The member feels good about himself and about his work, and he feels good about the company that provides the conditions that cause him to feel good. In turn, the company benefits not only from high standards of quantity and quality in workmanship but also from the members' good feeling which is expressed in the form of loyalty and in many other ways.

Talks to Wives

Occasionally President Irl C. Martin is invited to speak to social gatherings in the auditorium, and when the wives of the members are present they find that he is not an austere individual, but is a friendly person who can "talk like a Dutch uncle." It is under these conditions, for example, that Martin may tell the wives about the facilities the company has provided to make the Woodward plant a clean place to work, and why it is good for the men to keep themselves clean.

Then, in a typical talk on such an occasion, Martin persuades the women of the importance of their role in keeping their husbands mentally and physically fit for their jobs. Even in



Contrasting colors on all machinery plus high intensity general illumination from the ceiling and concentrated light from adjustable lamps help reduce fatigue, accidents, and spoilage, and lift the speed of production. Both the production and office areas are windowless

an ideal plant, Martin points out, fatigue is a natural result of a day's good efforts if a man has been working with the welfare of his family and of his company in mind. Therefore, "coddle them when they get home," Martin tells the wives. "Husbands love a little pampering," he explains, and adds, "It doesn't cost anything and it does a lot of good." Needless to say, the husbands in the audience appreciate Martin's appeal in their behalf. But the wives like it, too, because it stresses their importance.

Spending a family's income is also good for a few minutes' discussion in one of these speeches. Half of the trouble with wages, Martin points out, is caused by families with $40 incomes trying to have just as many luxuries as other families with $50 incomes, while $50 families try to live like $60 families. Here especially, he tells the families, wives can help by dissuading high-flier husbands from impulsive extravagances, at the same time curbing any unjustified spending of their own.

In other meetings when only the members are present, Martin frankly discusses the company's business. If business is picking up, he tells them how much. If the backlog of orders has slacked off, he tells them that, too.

"The people who work here are entitled to know these things," is the official view of Woodward Governor management.

On special occasions, the entire plant personnel is called to the auditorium on company time. Early in the war, when many of the members were relatively new, these meetings were held from one to three times a week. The purpose then was generally to show motion pictures of production techniques. About once a week, however, the meetings centered around a man-to-man discussion of national or local subjects having a direct or indirect influence on the welfare of the company and its members.

Usually, Martin holds these talks to 15 minutes and then spends up to 15 minutes longer answering questions from the audience. Recordings are made of these discussions so that the material can be repeated to the people of other shifts who cannot attend the meeting. Now the meetings are held only about once a month, but the benefits of the earlier meetings still remain.

Workers on Committees

Another major detail in this company's human relations program is the use of a "vertical committee system," which is an outgrowth of a multiple management plan.

As might be expected, there is little or no need for a grievance committee or any formalized grievance procedure in this concern. Instead, emphasis is placed upon suggestions.

"Every member is provided with a suggestion book for the purpose of submitting in writing any ideas that he may have relative to the operation of this plant. These suggestions may concern changes or innovations that the member believes would be desirable in the jigs, fixtures, tools, machines, set-ups, or machining and assembling procedures. Also, if the member observes conditions anywhere in the plant that detract from the general appearance or interfere with the working efficiency of those involved, or are hazardous and health-endangering, they may use this form to bring such conditions to the attention of the proper people and at the same time offer a suggestion to alleviate the conditions."

Right to Seek Aid

The foregoing is broad enough to cover most problems that might arise under the category of grievance, as well as constructive suggestions where no grievance exists. In addition, every member is reminded that all have a right "to seek the aid, counsel, or advice of any other member of the organization, up to and including the president of the company."

Added Group Functions

Beyond the realm of general matters covered by the suggestion procedure there are, however, a number of specific fields in which the vertical committee system functions. The structure of this system follows:

There are a senior executive staff and a junior executive staff, whose members are appointed by management. From the senior staff, management appoints the chairman of each of seven committees, and an assistant chairman from the junior staff. Committee members are elected by the plant personnel. The seven committees are: Legislative, veterans, finance, open door, recreation, vocational guidance, and health. All are 8-man com-

Even the hastiest glance at the Woodward Governor plant, with its simple, clean lines, is almost enough to convince a prospective "member" that here is a good plant to work in. Absence of windows provides assurance of modern facilities, and the ample parking space supplies more than a hint that the management gives a lot of thought to the convenience of the people who work here

mittees except the open door committee, which has 16 members.

The committees may inaugurate, analyze, discuss, make recommendations, or take action on matters which do not affect directly, and which are extraneous to, the usual activities of the company's main business. They do not have power or authority to take any action concerning the operation of the plant or upon any matter concerning the business that is primarily the responsibility of management. This still leaves a wide area of subjects within the committees' scope. In these, the chairmen have the power to veto any proposal, recommendation, or action of their respective groups, but the membership of any committee may override the veto by a three-quarters vote. This brings the proposal to the attention of the whole senior executive staff.

Recreation and Health

Recreational activities are an important adjunct of the good feeling. With plenty of land area in company ownership it has been possible to provide a baseball field and tennis courts for summer athletics, and the courts are flooded in winter for ice skating. In addition there is an area set aside for members who wish to garden.

In the field of sports, the company is represented with teams in the local baseball and bowling leagues. Also there are departmental teams engaging in these and other sports.

The auditorium is the center for many other activities. Under the direction of member committees, dances are held at frequent intervals. Motion picture shows with second-run Hollywood features are given twice a month on Saturday nights, for a nominal fee.

At company expense, every member gets a complete physical examination at least once a year including an X-ray of his teeth. "Deficiencies, if any, must be corrected at the member's expense," says the official statement of company policy. It adds, "Since it is just common sense that an individual cannot operate at top efficiency if suffering from physical difficulties, and since it would be unfair to the rest of the company if he does not keep himself at top efficiency, a member is subject to dismissal if he has not done all in his power to correct the deficiencies in a reasonable length of time."

Coupled with the foregoing are the many other measures provided to maintain a high standard of health. These include the air conditioning and illumination systems, the food standards maintained in the cafeteria, the rest periods, and the music—all factors previously mentioned from standpoints other than physical health.

General Benefits

Annual vacations are given to all members who have completed one full year of service. Hourly wage earners get one day of vacation after one year, three days after two years, one week after three years, and two weeks after six years of service.

Each member's life is insured for $500 three months after he goes on the payroll, and the amount is increased $100 a year until the maximum benefit of $1000 is reached.

Further on the subject of general remuneration, the company keeps a progress report card for every member. This rates the member in the characteristics that are considered important in determining his value to the organization. It is a rating based on the accumulation of day-to-day observations of the job performance, attitude, and personality of the individual by his supervisors.

A review of each member's work is made at the end of his first three months, and thereafter twice a year. At these times the supervisors discuss with each individual his progress report and wage standard. If after this conference the member believes the report is not a true picture of his value, he may ask for another rating in which he is privileged to name his raters. It is required that they shall be five members of the organization who are familiar with his work. The president or the personnel manager serves as chairman or mediator for any re-rating conference.

The company also has a bonus system. In this matter the Woodward philosophy is that "a fair wage does not necessarily result in the highest hourly, weekly, or monthly wage. It is the wage which can be maintained during the normal variations in the business cycle and still permit the development of a reserve to carry the company through the occasional sharp dips. It is the company's policy in periods of good income to pay out in bonuses that part of its income above reserve requirements."

TO INSURE LOW-COST PRODUCTION

8 Evaluate Pay

Case of R. G. LeTourneau, Inc.

W. W. KIMMEL
Industrial Relations Manager
R. G. LeTourneau, Inc.
Peoria, Ill.

TO BRING ORDER AND EQUITY into the job-and-rate confusion occasioned by rapid expansion during the first two or three years of operation at its Peoria plant, R. G. LeTourneau, Inc., set up a point-system job analysis plan which, without material change, has continued from that day to this.

From a company point of view, although the maintenance and development of the job analysis program has been costly in terms of time, patience, money, and effort, the returns on the investment—composed of such values as sound, fair, stable job-and-rate structures, the elimination of grievances on job descriptions and rates, the solution to stabilization problems, the satisfactions of genuine bargaining and, above all, the beneficial effects of the whole process upon employee morale—are immeasurably and increasingly worth while.

While in the beginning a much smaller number of jobs were involved, there are currently about 350 jobs classified under the plan, ranging from janitors to tool- and diemakers, and including occupations of wide variance such as shop clerical, welding, heat-treating, assembly, maintenance, and machine tool work.

Although the plan technically may have some of the flaws common to point-system rating plans, these faults have not made themselves apparent.

The plan itself was set up by the company's chief industrial engineer by the usual method of developing appropriate job requirements and rating forms, which were tested and adjusted until they were satisfactory for the purpose. Next, jobs were described and analyzed, without consideration of existing or proposed rates, and their relative values expressed in terms of possible range of point values which were established by the rating process. Then followed the customary statistical work to establish suitable point ranges and classes, together with the work of gearing the existing rate structure to this job structure. The resultant job structure placed in one of eight classes all the jobs in the shop, with the proper concentration of jobs in the middle classes.

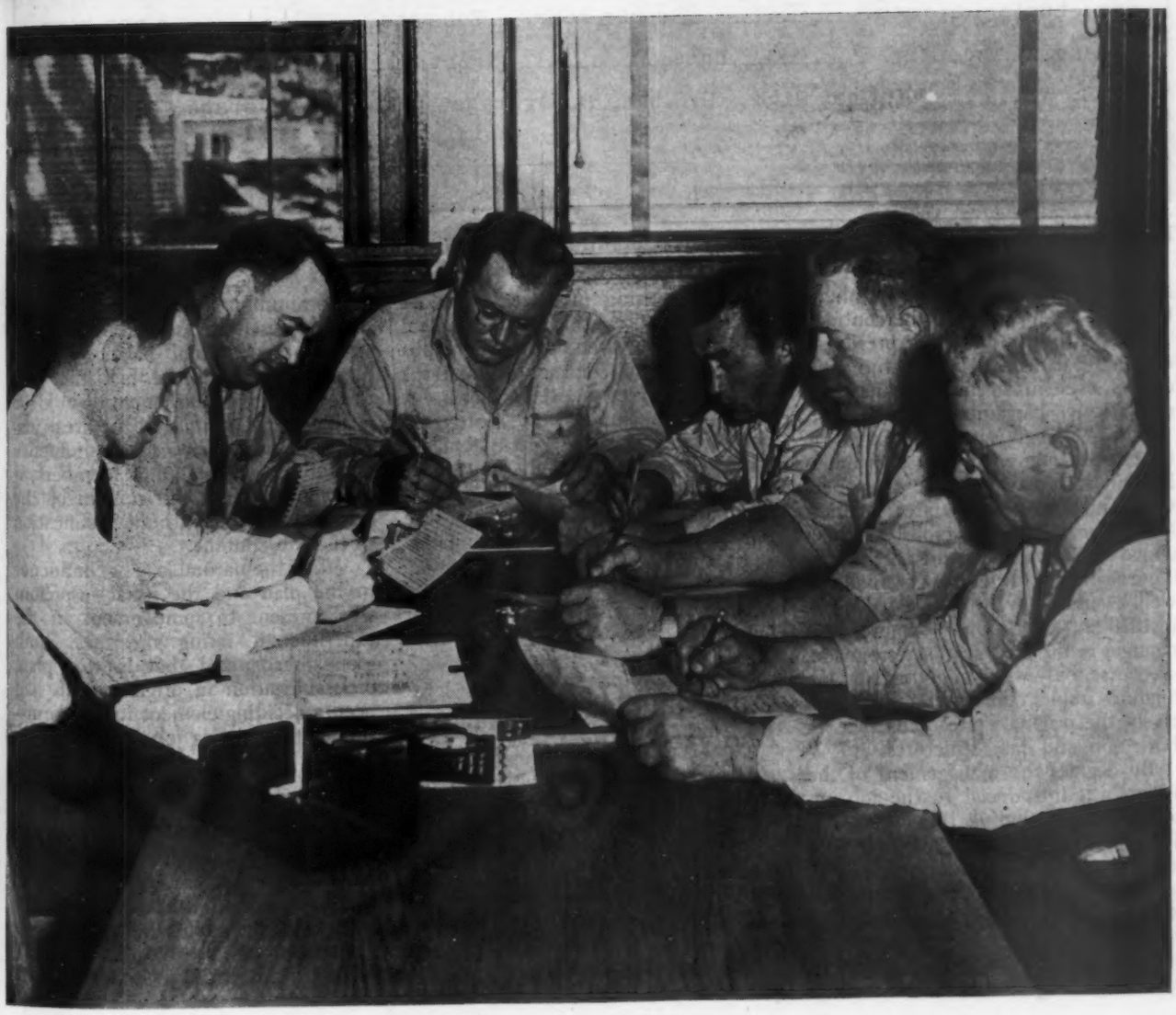
Job Analysis Plan Was Extended

Late in 1940 the company established a clearly defined personnel department and a personnel policy. Among the responsibilities of the new department was the work of maintaining and extending the job analysis plan as a service to the factory management. The established plan was carefully adhered to, and its coverage broadened wherever possible. Changes in the existing job and rate structures were made only by job analysis, and class and rate for new jobs were established in the same manner.

The present basic rate structure for hourly paid factory personnel was established late in 1941 by a contract with the International Brotherhood of Boilermakers, Iron Shipbuilders, and Helpers of America, AFL. Although the job analysis plan was not discussed during contract negotiations, the existing grouping of jobs into classes was, with a few adjustments.

Since the completion of the job analysis work, the joint committee continues to meet as necessary to handle description, analysis, and classification of new jobs as they develop, and to evaluate changes in jobs. Left to right, personnel research manager (and committee chairman), superintendent of Plants 1 and 4, three members of the local union's governing board, and the superintendent of Plants 2 and 3

Jobs and Accordingly



JOB DESCRIPTION:_____

_____

_____

_____

Number of men responsible for..... _____

Value of equipment responsible for..... $_____

Value of material responsible for..... $_____

Complexity of this process..... *_____

Effect on subsequent operations..... *_____

Attention to orders necessary..... *_____

Knowledge of other operations necessary..... *_____

Departments_____

Machines used_____

What supervisor is this job under...._____

Promotion opportunity....._____

Pay--beginning rate _____¢ per hour Top rate _____¢ per hour

Financial incentive_____none_____direct_____indirect_____

NOTE:*Write in (VH) Very High, (H) High, (A) Average, (BA) Below Average, (S) Slight

JOB NAME_____ JOB CLASS

A	B	C	D	E	F	G	H	I	J	K	L

First step in the analysis of a job by the joint committee is preparation of a "foolproof" job description ...

agreed upon and the description therefor made an appendix to the contract. The result was that the previously existing balanced job structure was carried over intact into the new era of collective bargaining for wages.

Since the base rates negotiated between the company and the union liberally corrected those instances where rates were below area practice, and in many cases established them above rates paid elsewhere, the LeTourneau rate structure, externally as well as internally, was in a balanced, justifiable condition. Subsequent changes in the class of jobs were made, of course, only when supported by job analysis results, thus preserving effectively the original state of balance in both job and rate structures.

By degrees the management of the union was introduced to the job analysis plan, including the use of the job requirements form, the rating work sheet, and the point ranges for the various classes. The introduction was made easier by joint company-union committee work on the revision of all job descriptions applying to jobs in the bargaining unit. These descriptions, comprising an agreed appendix to the original contract, were obsolete in many cases, while others—new jobs developed after contract negotiations—had no agreed-on descriptions. A committee, composed of representatives of factory management, the personnel department, and the union, thoroughly revised all existing descriptions and wrote descriptions for the new jobs involved, arriving ultimately at a complete list of well-written descriptions specifically designed to eliminate as far as possible the sources of burdensome grievances so prevalent in the original list.

Union Studied and Analyzed Jobs

Ultimately the job analysis plan and method were studied independently by the union. After numerous doubts and questions had been answered, a number of jobs whose class was in question were analyzed experimentally by a joint job analysis committee, consisting of the two shop superintendents, a member of the personnel department staff, and three members of the local union governing board. Company representatives carefully demonstrated the internal balance of the plan, to establish the fact that distorted crediting of elements would be readily apparent, and, in the great majority of cases, owing to the influence of the analyses of other members of the committee, could not affect the class of the job without justification in the job content.

While the natural lack of confidence in the plan and the usual suspicions were present to some extent in the experimental rating meetings, both groups recognized that in this plan, pre-stabilization in origin, which had been a deciding element in the formation of the existing job and rate structure, lay a fair and reasonable solution to many bargaining and stabilization impasses.

The experimental analyses had about the outcome to be expected. In some cases the union position was vindicated, and in others the company estimate of the job was borne out, with a net result satisfactory to both sides.

About this time, in the course of the settlement of some third-step

GENERAL	MENTAL	PHYSICAL	TEST SCORES
Sex M_____ F_____	None _____		PERSONALITY
Age Pref. _____	Read & Write _____	HEIGHT _____	Over-all _____
Married _____	Add & Subt. _____	WEIGHT _____	Sociability _____
Single _____	Elem. Math. _____	STRENGTH _____	Stability _____
Other _____	Blueprint _____	EYESIGHT _____	Confidence _____
_____	High School _____	HEARING _____	MENTAL ABILITIES
_____	College _____		Perception _____
_____	Special _____	RIGHTHANDED _____	Numbers _____
EFFORT	CONDITIONS	LEFTHANDED _____	Verbal _____
a. Strenuous _____	a. Abnormal Temp.___		Memory _____
b. Abnormal Pos.___	b. Steamy _____	CHARACTERISTICS	Induction _____
c. Climbing _____	c. Fumes _____	Cooperative *_____	Reasoning . _____
d. Pushing _____	d. Dusty _____	Initiative *_____	Total _____
e. Heavy _____	e. Hot _____	Tactfulness *_____	MECHANICAL ABILITY
f. Lifting _____	f. Wet _____	Dependable *_____	Mech. Abil. I. _____
g. Pulling _____	g. Glaring _____	Judgment *_____	Mech. Abil. II._____
h. Light _____	h. Dirty _____	Orderliness *_____	Set-up Ability _____
i. Walking _____	i. Noisy _____	Alertness *_____	Dexterity _____
j. Stooping _____	HAZARDS	Discipline *_____	Coordination _____
k. Monotonous_____	Disease * _____	Executive *_____	OTHER
l. Standing _____	Accidents* _____		Blueprint Read._____
m. Sitting _____	Strains * _____		Stenographic _____
			Clerical _____

Length of time to learn job_____months
Length of experience needed_____months

NOTE:*Write in (VH) Very High, (H) High, (A) Average, (BA) Below Average, (S) Slight

...in which care is taken to make an exact statement of what is done by the worker on the job in question

grievances between the company and the union's international office representatives, the international vice-president of the union involved, after witnessing an actual analysis by the joint committee, gave tacit approval to union cooperation in the use of the plan for the resolution of job class problems. Thereafter, a number of third-step grievances involving job-class differences were settled by the job analysis method. It was agreed that a majority of the scores reached by the committee on such jobs would decide the proper class, whether an increase in class was involved or the establishment of subordinate, lower class jobs, and that a joint Form 10 would be filed with the Regional War Labor Board asking permission to make the changes indicated by analysis results.

In return for company concessions establishing the effective date of class and rate changes, if approved by the Regional War Labor Board, at the date of the grievance, the union agreed to avoid any attempts to process job-class grievances in volume, to set up favorable retroactive dates, and, as well, to raise job-class questions for analysis before they became grievances.

Arising out of the mutually satisfactory outcome of these joint experiments in job analysis was an informal agreement to settle, by re-analysis, a number of open questions on the class of additional jobs, which, while not actual grievances, were potential problems and sources of friction. In addition, there were some jobs which the company felt should be supported in the structure by lower class jobs in the same occupation, in order to remove objectionable situations where operators doing very limited work were receiving the same rate as skilled all-around first-class operators, for want of appropriate descriptions covering simpler, lower class jobs. Finally there were new jobs to be covered by descriptions, analyzed, classified, and submitted for stabilization approval.

A permanent committee of six members comprising the same personnel as the experimental committee, with the personnel department representative as informal chairman, began work, in regularly scheduled meetings, to dispose of the accumulated problems. Using the jointly revised descriptions mentioned above and the originally agreed-on rule as to decision of class by the majority of the six scores, the committee, over a period of several months, analyzed 99 jobs. Comparatively few of this number were grievance cases. Of the total analyzed, which represented all of the approximately 350 jobs in the unit which were questioned, 51 were found to be properly classified as they were, 22 to belong in the next higher class, 5 in the next lower class, and 22 new jobs were assigned classes agreeable to both parties.

WLB Approved Findings of Committee

The entire findings of the committee, submitted in a series of exhaustively prepared Form 10's, were approved by the Regional War Labor Board. Tie-score cases, when they occurred, were referred to the industrial relations manager and the union business representative, who discussed the analyses in question and arrived at reasonable compromise on the high

R. G. LeTOURNEAU, INC.
Peoria, Illinois

JOB RATING WORK SHEET

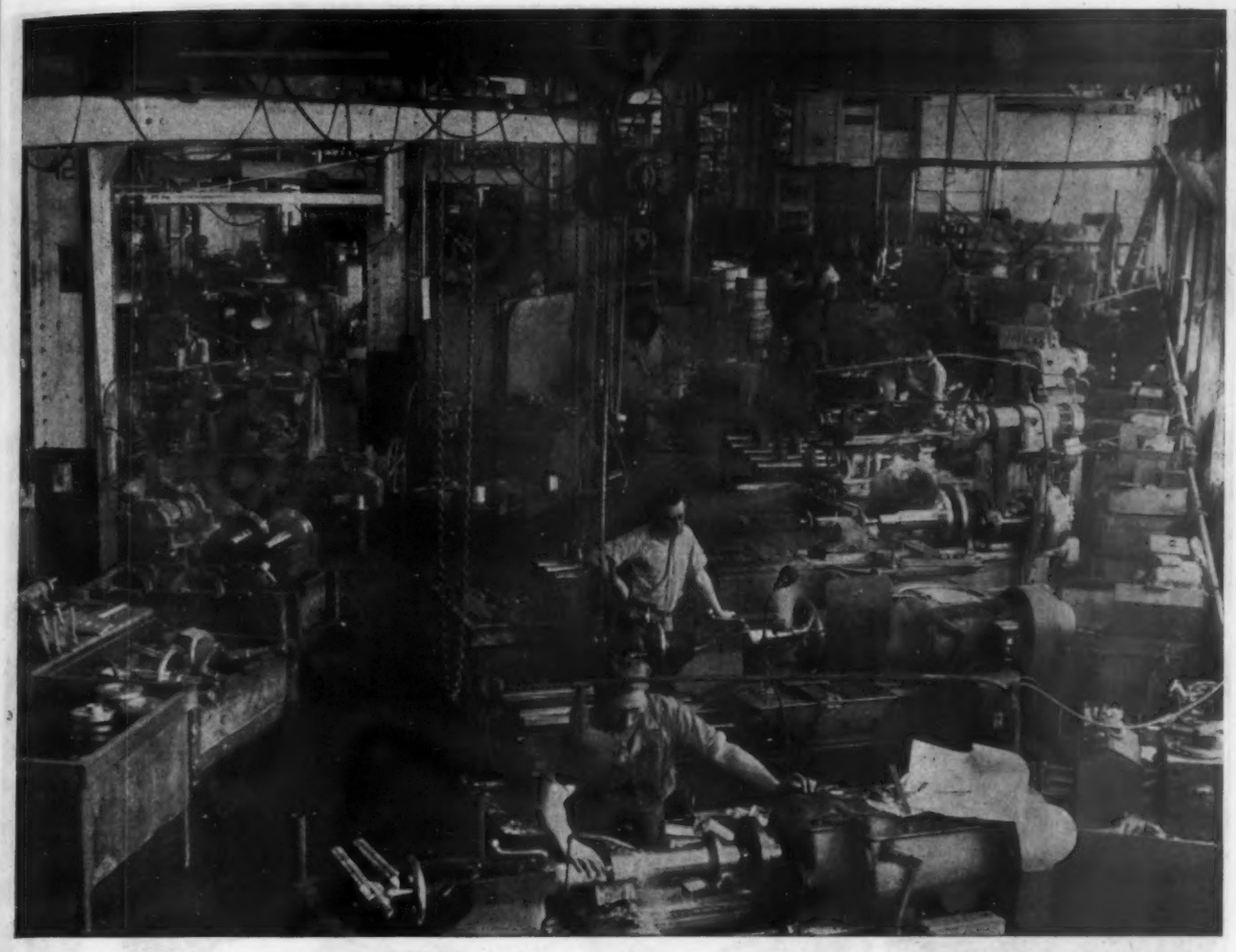
RATED BY_____ JOB_____

DATE_____ DEPARTMENT_____

FACTORS	CROSS THE CORRECT SQUARE FOR EACH FACTOR				
1. EDUCATION	College 5	High School 4	Elem. Math. 3	Add & Sub. 2	Read & Write 1
2. EXPERIENCE	Over 12 mo. 15	9 to 12 mo. 12	6 to 9 mo. 9	3 to 6 mo. 6	0 to 3 mo. 3
3. LEARNING PERIOD	Over 3 yr. 10	1 to 3 yr. 8	6 mo. to 1 yr. 6	3 to 6 mo. 4	1 to 3 mo. 2
4. MENTAL EFFORT	Very High 5	High 4	Average 3	Below Av. 2	Slight 1
5. MECHANICAL ABILITY	Very High 5	High 4	Average 3	Below Av. 2	Slight 1
6. PHYSICAL EFFORT	A, B, C, D 10	E, F, G 8	H, I, J 6	K, L 4	M 2
7. CONDITIONS	A 5	B, C 4	D, E 3	F, G 2	H, I 1
8. HAZARDS	Very High 10	High 8	Average 6	Below Av. 4	Slight 2
9. RESPONSIBILITY (EQUIPMENT)	Over $50M 5	$25M to $50M 4	$10M to $25M 3	$1M to $10M 2	Less $1M 1
10. RESPONSIBILITY (MATERIALS)	Over $50M 5	$25M to $50M 4	$10M to $25M 3	$1M to $10M 2	Less $1M 1
11. RESPONSIBILITY (MEN)	Over 16 5	11 to 15 4	6 to 10 3	2 to 5 2	1 1
12. COMPLEXITY	Very High 5	High 4	Average 3	Below Av. 2	Slight 1
13. EFFECT ON SUBSEQUENT OPERATIONS	Very High 5	High 4	Average 3	Below Av. 2	Slight 1
14. ATTENTION TO ORDERS	Very High 5	High 4	Average 3	Below Av. 2	Slight 1
15. KNOW OTHER OPERATIONS	Very High 5	High 4	Average 3	Below Av. 2	Slight 1
16. COORDINATION	Very High 5	High 4	Average 3	Below Av. 2	Slight 1

PRESENT HOURLY RATE_____ TOTAL_____

Translation of the job requirements data to the job rating sheet is a comparatively easy matter because members of the committee have learned to observe a decent respect for the other fellow's opinion



Some 350 jobs are currently classified under the LeTourneau point-system job analysis plan, ranging from janitors to toolmakers and including welders, heat-treaters, assemblers, and maintenance workers

or low credited elements responsible for the ties.

Rules of procedure emerged almost at once in the committee meetings, lending consistency and effectiveness to the work. Likewise, mutually satisfactory understandings as to maximum and minimum meanings attached to the various elements as listed on the rating sheets were rapidly developed. Discussions were sometimes lengthy and other times brief, but familiarity tended to reduce analysis time per job.

Permanent Agreements Were Reached

One rule rigidly observed was avoidance of discussion or consideration of rate during analysis. As jobs were discussed, permanent agreement was made on descriptions used, and on job requirements. Representatives of both groups found it possible in most cases to avoid unreasonably high crediting which would result in differences difficult to unravel.

Union representatives began to be sold on the plan as a measuring device which, if fairly and consistently applied, would yield a stable, explainable job-and-rate structure, to the decided advantage of all concerned. An exchange of respect for opposed viewpoints resulted in a merging of interests into the main purpose of doing a sound, lasting job. While meetings were not without pre-planning, strategy, and oratory on both sides, and often included surprises as to both union and company representatives' final scores, it became apparent to all that, regardless of shortcomings in the plan in the direction of too fine or too coarse measurements, the result would be fair and reasonably accurate as long as the committee as a whole made a sincere effort to give fair credits for all the elements in each job analyzed. There was also a general recognition of the relationships between job elements, and of the controlling and limiting influence of these relationships as far as consistent, unjustifiably high crediting of all elements was concerned.

Since the completion of the job analysis work detailed above, the committee continues to meet as necessary to handle description, analysis, and classification of new jobs as they develop, and to evaluate changes in jobs. Although the greatest number of requests for job analysis originate with the union, it is frequently necessary for the company to inaugurate job analyses to get answers to rate problems. The work of the job analysis committee frequently touches that of another joint committee charged with developing agreed-on advancement patterns in the various job families in the bargaining unit. This merging of effort arises, of course, out of the description and classification work of the first group, on which the work of the second committee is based largely.

In the analysis of a job by the committee, the first step is the preparation of a job description. Long experience and a wide variety of vigorous differences over the interpretation of the original descriptions have taught all of the members of the committee the

importance of a sound, "foolproof" description which, apart from its definitive value in grievance situations, is used in connection with employment, Selective Service, and advancement, to mention but a few of its more important utilities.

For such reasons, the committee exerts itself to work an exact, simple, clear statement of what is done by the worker on the particular job in question. Where requirements of training, special experience, qualifications or skills, and quality performance may affect the job class or the ability to perform the job, these elements or requirements are clearly and simply expressed in the agreed-upon description. Descriptions are also prepared with a view to their use in the rating portion of the analysis work, a practice which lends consistency and continuity to the entire set.

The average description consists of four or five lines, and eliminates such vagaries as "must be able to," "be interested and able to follow orders," and "know something about," thereby ruling out possibilities for misunderstandings based on broad or narrow interpretations by stewards or supervision. Standard nomenclature, both for job titles and for job descriptions, has been developed and put into use. Where qualifying phrases have been employed, specific words with an unmistakable meaning have been used.

Job Requirements Set Up With Equal Care

The same general care has been used in setting up job requirements other than the job description, so that the employment office, other sections of the personnel department, factory management, and union representatives would have a concise, accurate record with which to work. The obvious relationship between the items appearing on the job requirements card and those on the rating sheet will indicate the need for the care with which the analysis material is gathered and originally entered on the job requirements card.

In analysis meetings both sides may bring in, as consultants, persons from the plant who are thoroughly familiar with the work involved, so that a more exact knowledge of the job may be had. Once the job description is agreed upon, the committee proceeds to discuss the remaining entries to be made on the job requirements card, in the order in which they appear, arriving at an understanding on each.

Since none of the jobs analyzed by the committee involves supervisory responsibility, number of men is not considered. Value of equipment is entered in dollars, and is considered to be the original cost of the machine or other equipment directly used in doing the particular job being analyzed. Where shop supervision cannot furnish these values, purchasing department records furnish the dollar amount to be used. In determining value of material, the value of the single piece or order of work which

Job evaluation program at the Le-Tourneau plant insures a sound job-and-rate structure, the elimination of grievances on job description and rates, the solution to stabilization problems, the satisfactions of genuine bargaining, and better employee morale

might be scrapped by careless work is considered, as well as such items as responsibility of the operator for set-up, for checking his own work, and the responsibility of the inspection.

Complexity of the job is estimated in terms of the scale across the bottom of the card and by comparison with other jobs.

Effect on subsequent operations is determined by considering what checks are furnished by inspection to prevent further work on defective parts or structures, and what loss may occur in subsequent operations by faulty, careless work on the part of operators performing the job involved.

In rating the necessity for attention to orders, such things as whether or not the operator works from verbal orders, rough sketches, procedure cards, shop prints, or a combination of these forms of orders are taken into account, as well as whether the operations are routine and repetitive or vary widely from job to job.

Knowledge of other operations necessary is determined by consideration of the type of job as indicated by ratings on such factors as attention to orders, effect on subsequent operations, complexity, and, as well, whether or not the job is repetitious and closely governed by procedures and blueprints.

The balance of the items on the obverse of the requirements card, such as promotion opportunity, incentive status of the job, and supervision, are purely employment and training aids, and, although these items are entered by the committee, they are not reflected on the rating sheet and have no effect on the ultimate class of the job.

In completing the reverse side of the requirements card, the general information space, again chiefly a hiring aid and guide, is filled in. Next the mental requirements as related in item 4 on the rating sheet are threshed out and agreed upon by determining what minimum amount of formal education is necessary to do the job under analysis. Effort, working condition, and hazard elements are then evaluated, in the first two cases by checking the applicable descriptive words, and in the latter by rating in terms of general knowledge of the actual job.

Finally the length of time required to learn the job and the length of experience needed are agreed upon, usually in the reverse order of their appearance owing to the relationship and the company's particular methods of upgrading. Minimums are generally arrived at in both cases on the basis of past practice and knowledge of how much time an employee, upgraded on the basis of required experience qualifications, will require to acquire reasonable proficiency.

Again, the material with regard to physical data, test scores, and personality characteristics is for employment and training uses, has no effect on the job class, and is therefore not reflected on the rating sheet. In time, it is hoped that research in material available from the testing program and other personnel record sources will establish information on test scores useful in employment and transfers, although at present no use, either for job analysis or employment purposes, is made of these sections of the job requirements card.

Once the requirements cards have been completed and the description on the chairman's card has been initialed by the other members of the committee, the work of rating is begun.

The translation of the requirements data to the rating sheet is a comparatively easy matter, particularly where elements have been rated on the requirements card. No great amount of time is spent in discussions or arguments as to credits to be given in rating the various elements, the individual members of the committee observing a decent respect for one another's opinions. Experience has shown the committee that distorted crediting unjustified by the facts quickly reveals itself, and compels distorted higher or lower crediting in other elements which adjust the original distortions. As a result, as time goes on, there is an increasing tendency on the part of all the members of the committee to expedite the job by rating in a fair and impartial manner.

Elements Are Expressed in Ratings

Of the elements on rating sheet, four—education, mental effort, mechanical ability, and coordination—are expressed in ratings by personal judgment of each committee member after consideration of the various factors entered on the requirements card, such as mental requirements, complexity, and physical effort.

Following rating by each committee member, scores are added from the element scores in the boxes checked. The class point range in which the majority of scores fall determines the correct class for the job, subject, of course, to War Labor Board approval where new jobs or changes in class are involved.

Point ranges for the eight classes of jobs run from a maximum of 31 for the lowest group of jobs (Class A) to a minimum of 92 for the highest group (Class H). Rates paid for the various classes of work are single rates, and apply equally to all jobs in the class. There are no ranges, and performance of the job is the only requirement to receiving the rate. Length of service is recognized in terms of job security, shift preference, vacation choice, and advancement preference. Likewise, merit is recognized in terms of regular advancement, and in many cases by consideration for special jobs, or for advancement to supervisory positions.

TO INSURE LOW-COST PRODUCTION

9 Keep and Plant

Case of Remington Arms Company, Inc.

L. M. BLAKELY
Works Engineer
Remington Arms Company, Inc.
Bridgeport, Conn.

IN THE BRIDGEPORT PLANT of the Remington Arms Company, Inc., maintenance activities may logically be divided into the six categories that follow:

1. Buildings, including general manufacturing, storage, and special function, such as the power house, roundhouse, garage.

2. General service equipment, in and part of buildings, such as steam, water, light, power, gas, and air lines, elevators, and fire protective equipment and alarm systems.

3. Special service equipment such as power drives, both group and individual, trucks, conveyors, chutes, and heating, ventilating, and air conditioning equipment.

4. Production equipment, which can be further subdivided into machines used in case and shell manufacture, primer manufacture, assembling and charging of cartridges and shells, inspection of components and products, packing.

5. Special equipment, including machine shops, ballistic ranges, technical laboratories.

6. Yards and grounds.

Each of these presents its particular problems, which must be handled in some suitable manner.

Some conception of the work and responsibilities of the maintenance department will be obtained from the fact that the Bridgeport plant comprises a total of 450 buildings, covering 800,000 square feet. Included in these structures are small hydrant houses of wood construction; powder storage buildings of sheet metal; one-story brick with steel frame manufacturing buildings; three- and four-story brick with steel frame buildings; some older mill-type construction buildings with timber frame structures; a group of brick, three-story office buildings; a ballistic range, 600 yards long, of concrete construction; and a nine-story brick and steel shot tower. In these buildings there is a total of 1,500,000 square feet of usable floor area, with floor surfacing of many different kinds and types, such as factory maple, magnesite, concrete, asphalt and asphalt tile, linoleum, fiberized mastic, and sections of spark-proof and spark-proof-conductive floors.

There is a total of 393,000 square feet of window and skylight openings, mainly steel sash and frames, and 752,000 square feet of roofed area, covered for the most part with 20-year bonded built-up roofing.

In the plant there are 47 miles of steam piping, ranging in size from 8-in. mains at the power house to ¾-in. returns from some of the heating units, together with 1 mile of outside overhead steam mains.

In addition to this steam piping there are more than 37 miles of water, gas, air, fuel oil, and sewer and drain piping. Connected to these piping systems are 30 hot water storage tanks, 115 electric water coolers, 200 pumps (steam, water, and vacuum), and 35 air compressors.

Underground Lines

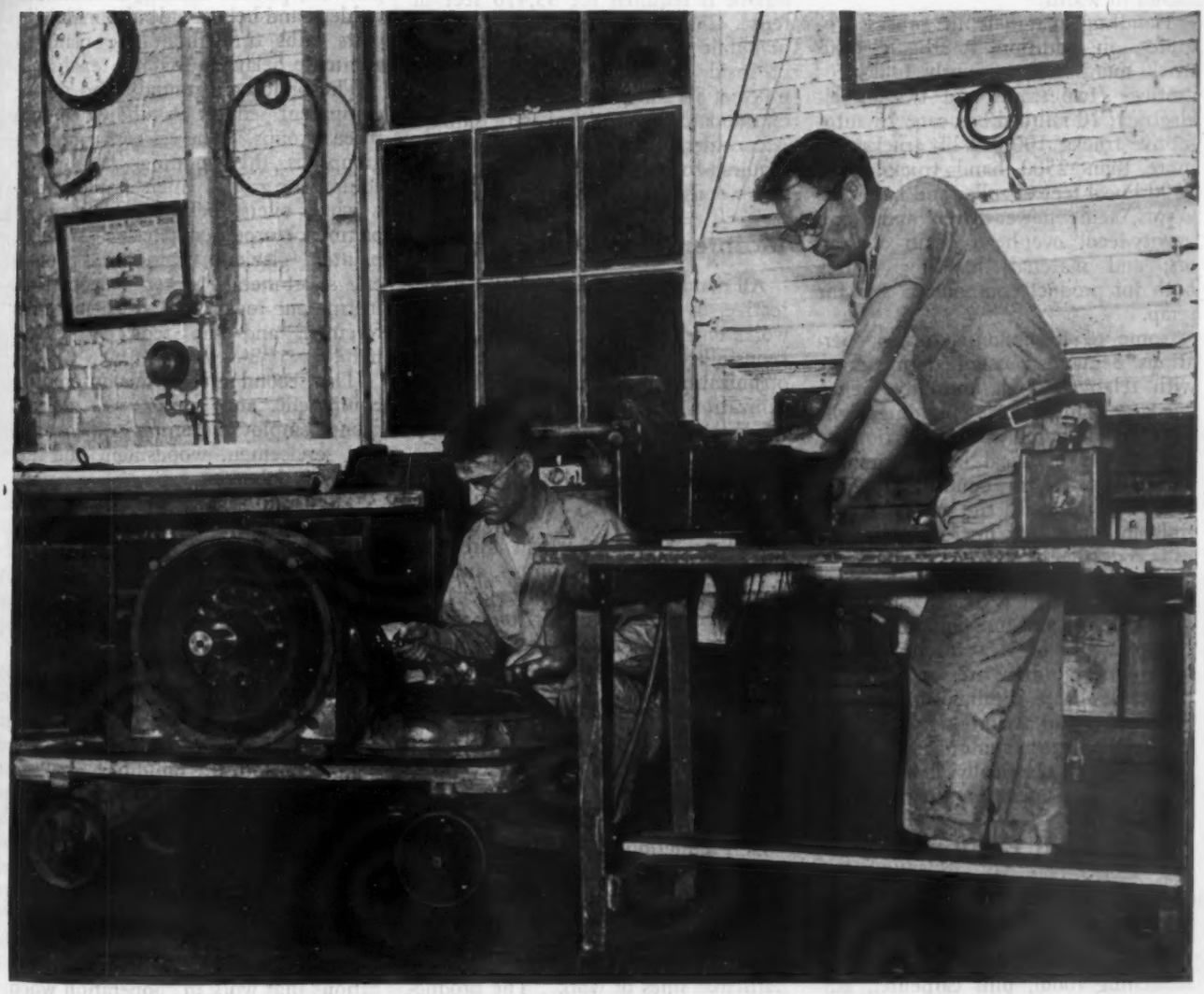
There are 8 miles of underground sewer mains from 4 to 35 inches in diameter, and 7 miles of underground water mains from 4 to 12 inches in diameter, also a separate loop system for the fire mains to the buildings.

Fire protection service consists of an alarm system with 150 boxes, and 27 miles of sprinkler piping and heads, together with a 100,000-gal. water tower, fire pumps, and other associated equipment.

In the plant there are 34 elevators, both passenger and freight.

It is necessary to maintain and service 180 power transformers, ranging from the main power banks of 3000-kva. capacity to the small 500-

Equipment in Condition



This motor has been cleaned and is getting an insulation resistance test in the maintenance shop

volt-ampere transformers for control circuits; also 6000 fluorescent and 12,000 incandescent lighting fixtures, as well as an extensive outside lighting system.

Finally there is a public address system with central control booth and 180 speakers located throughout the plant.

Special Service Equipment

A total of 2300 electric motors ranging from fractional to 60 horsepower are used on individual drives or to drive the lineshafts of group drives. In this category there can also be included 400 electric hand tools used for both production and maintenance work; 250 temperature recorders, pyrometers, and controls; 150 exhausters and blowers used mainly for ventilation or for exhausting noxious fumes and dust; and 45 electric trucks. Also to be maintained and serviced are 22,000 lineal feet of line and countershafting, together with 105,000 lineal feet of belting ranging from 1 to 12 inches in width.

Handling materials in process requires, in addition to the electric trucks mentioned previously, four locomotives (two steam and two diesel-electric); 10 railroad box cars; 28 automotive trucks; 100 jack-lift trucks and more than 2500 hand trucks; plus 7000 lineal feet of roller and belt conveyors, some power-driven and some gravity-feed; over-head chain conveyors; and materials handling chutes both for product components and for scrap.

Some of the manufacturing operations demand constant temperature with relatively high humidity, hence one large manufacturing building, eight storage buildings, and a portion of one of the technical laboratories are equipped with air conditioning systems, together with the necessary controls and recording instruments.

Production Equipment

Production and tool equipment consists of a total of 5100 machines ranging from large draw presses to the extremely delicate mechanisms used in the loading and assembling of primers. By far the greater number of these machines are especially designed for the particular operation they perform.

Special Equipment

Proper handling of corrective and preventive maintenance requires centrally located and completely equipped machine, forge, and welding shops, hardening room, plus carpenter, pattern, and pipe shops, together with area machine and area maintenance shops. In addition, the technical laboratories are provided with machine tools as well as other special maintenance equipment.

There are also 12 ballistic ranges with sand backstops that must be changed periodically, an additional service rendered by the maintenance department.

Yards and Grounds

The last, but not a minor item, of maintenance work is the care and upkeep of grounds, yards, fences, parking lots, roads, walks, and railroad sidings. The plant site comprises 386 acres of land together with four lakes covering an additional 26 acres. This site is divided into two sections, consisting of the main manufacturing area in the center of East Bridgeport, and the primer manufacturing and powder storage area of approximately 345 acres of wooded land located near the city limits.

In these two areas, maintenance service is required for 33,470 feet of fence, 23,000 square feet of outside or public sidewalk, 70,000 square feet of inside walks, 6 parking lots, 10 miles of automobile roads, and 3 miles of standard-gage railroad with sidings. A considerable amount of work is also required to keep the surrounding fields and woods in proper condition.

Maintenance Organization

All maintenance, preventive and corrective, is the responsibility of the works engineer. To discharge that responsibility requires a maintenance organization of 267 persons. The organization of this force is shown in the chart above and on the facing page.

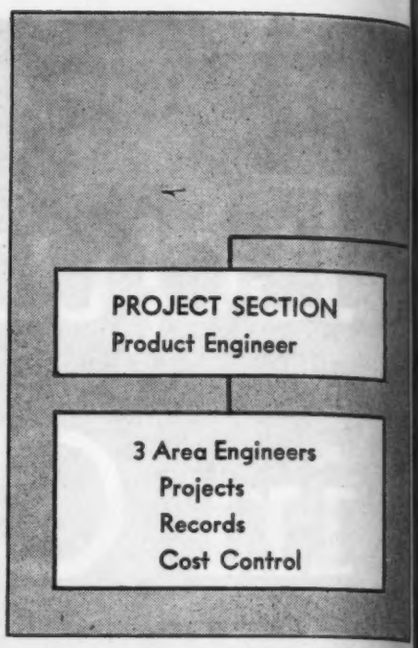
It will be seen that the maintenance department consists of three major groups:

1. Project section, which is responsible for records, cost control, and obtaining authorization of projects for corrective work. This section consists of a project engineer, area engineers, and the necessary clerical force.

2. Buildings, grounds, and service equipment section, which in turn is divided into three groups. It utilizes the services of several engineers and one draftsman.

3. Production equipment section, which utilizes the services of a number of engineers and draftsmen.

The latter two sections employ 225 craftsmen, especially trained in their particular lines of work. The production equipment section employs machinists, machine operators, scale repairmen, pattern makers, blacksmiths, welders, and helpers. It also maintains parts cribs throughout the plant to eliminate delays in making repairs.



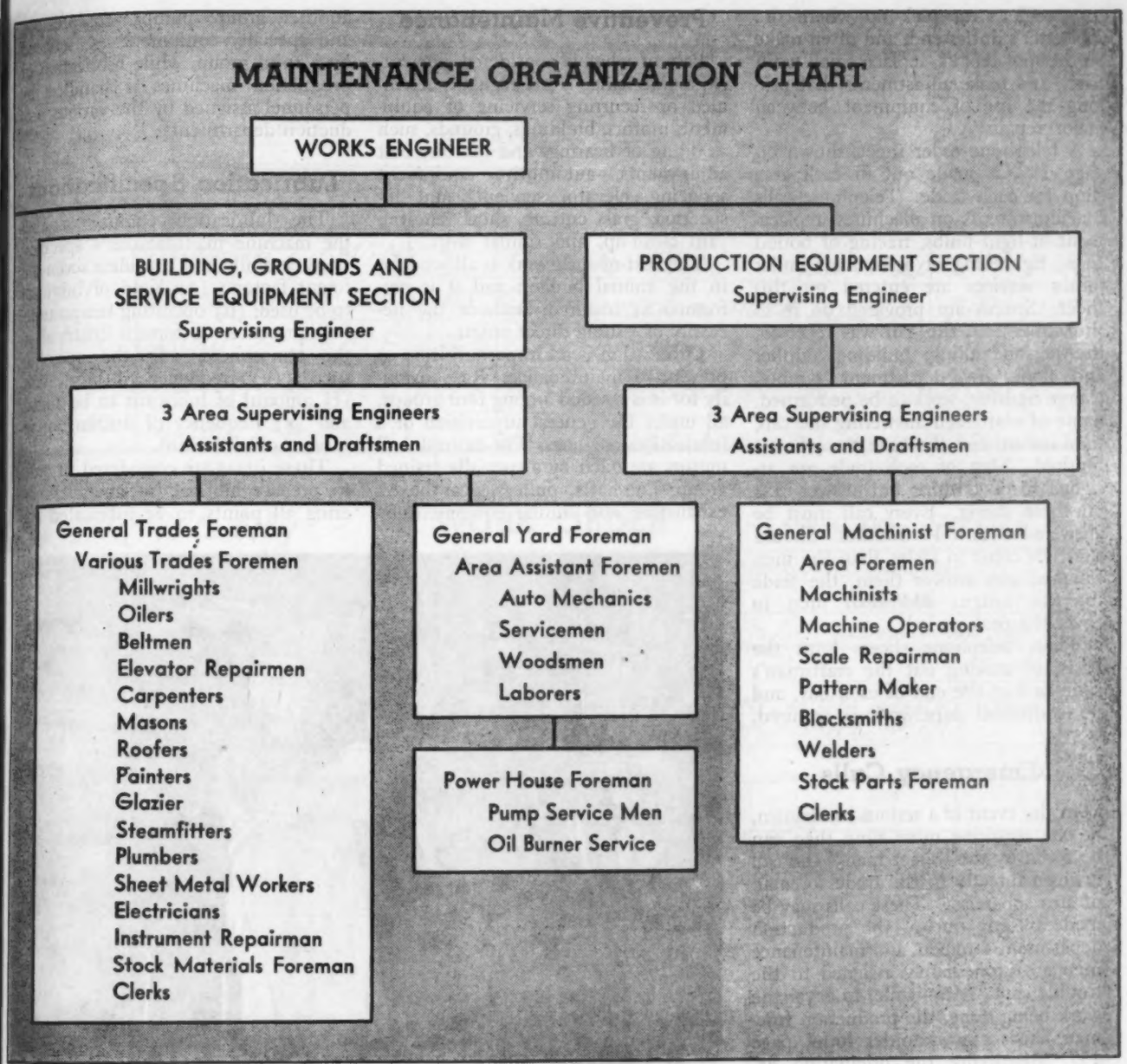
The buildings, grounds, and service equipment section is subdivided into three groups. The largest of these groups is the building and service equipment group, which employs millwrights, oilers, beltmen, elevator repairmen, carpenters, masons, roofers, painters, glaziers, steamfitters, plumbers, sheet-metal workers, electricians, instrument repairmen, stock materials foremen, and the required clerical help.

The second group, the automotive equipment and yard and grounds group, employs automobile mechanics and servicemen, woodsmen, and the necessary laborers.

The third group is the power house and locomotive equipment group, which actually is an operating division but which also employs pump and oil burner servicemen.

Area Maintenance Shops

The plant is divided into three geographical areas—the Barnum Avenue area, the Boston Avenue area, and the Park area. Both the buildings, grounds, and service equipment section and the production equipment section maintain a maintenance shop in each of the geographical areas, to minimize delays in reaching the place where maintenance work is required. Each area comes under the supervision of a section engineer, with parallel organizations that work in cooperation when problems involving more than one sec-



tion arise. Each section also has the necessary specialists and draftsmen who work with and for the various area engineers as the work in the different locations increases or demands special consideration.

Both the production equipment section and the buildings, grounds, and service equipment section maintain the spare parts, materials, and supplies most often used. These items are controlled by parallel perpetual inventory card systems in each section, with low-level re-order points. All parts and supplies are ordered by either the engineering supervisors or the materials foreman. Stocks are based on mortality experience or use-requirement experience, so that at no time is the maintenance department without the means of making at least a temporary repair.

Planning, Execution

For identification purposes each building, machine, motor, and other piece of equipment is numbered. In the case of machines, motors, and other equipment, a brass tag bearing the number is securely attached when the item enters the plant or is constructed there, and is removed only when that item is finally scrapped. A perpetual inventory record is kept for each separate capital asset, and a plant register card is made out for each. Plant register cards used for motors and for machines are illustrated on page 158.

These cards are filed by name. For instance, all motors come under one section, all exhausters under another, and so on. Cards are cross-indexed in a complete numerical file. They are kept up to date as to repairs, alterations, and improvements, together with the date and cost, and are constantly referred to and used by the supervising engineers.

The Maintenance Program

The entire maintenance program is designed to prevent breakdowns. This program is divided into two classifications, called preventive maintenance and corrective maintenance, respectively. Before an attempt is made to distinguish between the two, however, it must be realized that breakdowns do occur and emergency repairs must be made. The machinists, millwrights, beltmen, and other maintenance men work in close conjunction with the production department's toolsetters and foremen. The mechanics assigned

to specific areas pick up where the toolsetter's duties end, and often make on-the-spot repairs, replace small worn parts, and make adjustments that prolong the life of equipment between major repairs.

A telephone order sheet, shown on page 157, is made out in each area shop for each trade. Telephone calls for adjustments on machines, replacement of light bulbs, freeing of bound traps, tightening of belts, and similar minor services are entered on this sheet. Spaces are provided on it to show the time the call was received, the person calling, building number and floor, the department symbol, charge number, work to be performed, name of craftsmen answering the call, time issued, and the time the job was finished. Men of each trade are assigned to do nothing but answer calls on these sheets. Every call must be answered within 15 minutes. Should the calls come in faster than the men assigned can answer them, the trade foreman assigns additional men to cover the peak period.

These telephone sheets form the basis for making out the craftsman's time card at the end of each day, and no additional paperwork is required.

Emergency Calls

In the event of a serious breakdown, or one requiring more time than can be given by the "sheet man," the call is given directly to the trade foreman or area supervisor. These calls may be made by any one of the production department foremen, and maintenance men are immediately assigned to the trouble spot. Meanwhile, to cover the work being done, the production foreman issues a work order form, page 157, identifying the originating department and the particular equipment or section of building to be worked on.

These work orders are also originated by the supervising engineers or inspection mechanics of the maintenance department when inspection discloses that minor repairs are necessary immediately.

One copy of this work order is retained by the maker, one is retained by the section doing the work, one is sent to the cost section of the treasurer's office upon completion of the work, and the fourth is sent to the project section for record purposes.

The work order form is further used by production job foremen and supervisors to call the attention of supervising engineers in the maintenance department to conditions that need repair or correction, but which will involve study before work is done.

Preventive Maintenance

Part of what is considered preventive maintenance is the regularly scheduled or recurring servicing of equipment, motors, buildings, grounds, such as oiling of bearings and motors, belt adjustments, automotive equipment servicing, elevator servicing and inspection, grass cutting, snow removal, yard clean-up, and similar work.

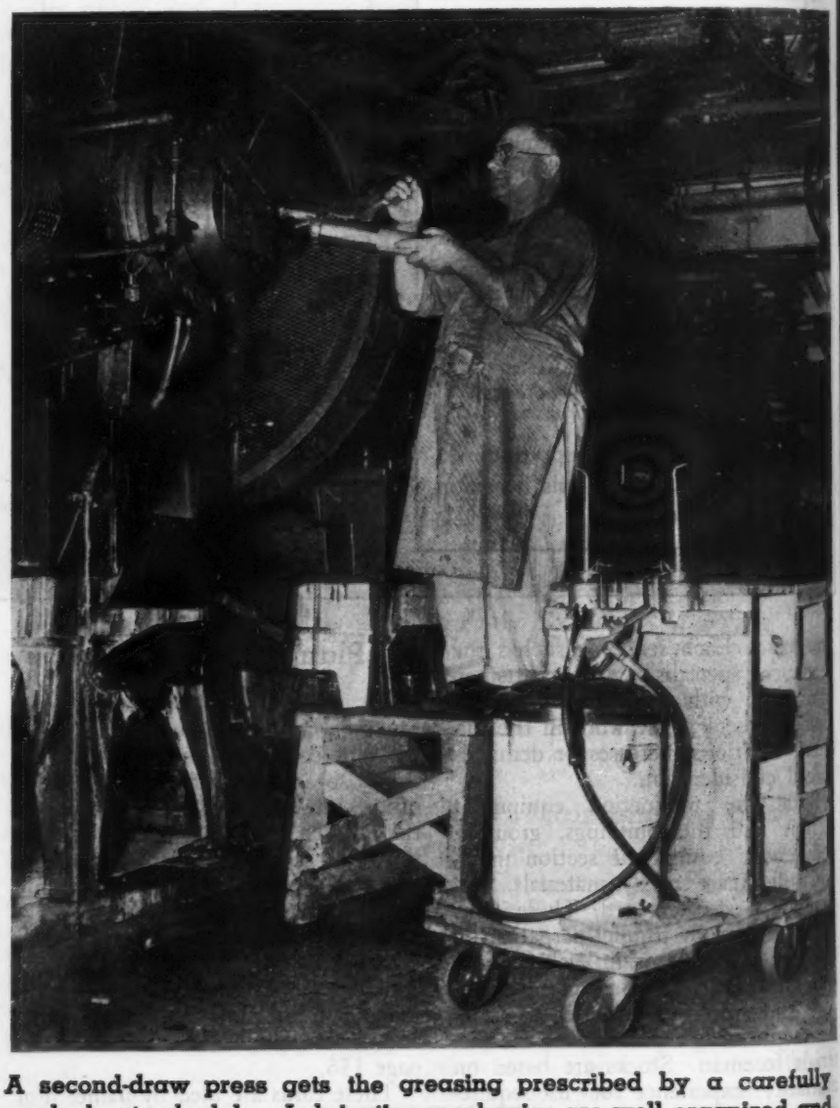
The cost of such work is allowed for in the annual budget, and it is performed as required, without the necessity of issuing direct orders.

Lubrication is an important item of preventive maintenance. Responsibility for it is divided among four groups, all under the general supervision of a lubrication engineer. For example, all motors are oiled by a specially trained group; lineshafts, pulleys, gear boxes, exhausters, and similar equipment by another group; pumps, compressors, and specialty equipment are serviced by a third group; while lubrication of production machines is handled by personnel assigned by the various production departments.

Lubrication Specifications

The lubrication engineer studies the machine manufacturer's specifications carefully and considers seven different factors: (a) Kind of lubricant to be used; (b) operating temperature; (c) presence of foreign material in the atmosphere; (d) the operating speed; (e) frequency of lubrication; (f) amount of lubricant to be added; and (g) frequency of flushing or replacing old lubricant.

These items are considered in order to prepare lubrication schedules covering all points to be lubricated and



A second-draw press gets the greasing prescribed by a carefully worked out schedule. Lubrication mechanics are well organized and trained. Selection of lubricants and frequency of lubrication are based on a study of seven different factors that must be considered in order to make sure that each machine is properly serviced

TELEPHONE ORDERS

Department AWE Electricians Date 6/25/45

Time Received	Received From	Bldg. No. and Floor	Dept. Symbol	Charge Acct.	Work to be Performed	Issued to	Time Issued	Time Finished
1 00	Objeski	16-2	MTN	9	Check fan	Bunny	1:15	1:35
101	Hatterly	343-4m	DB	A 118	Check switch on mach	Harold	1:20	1:30
130	Maury	21-3	BIE	A 163	Check fan	Bunny	1:35	1:40
2:30	Smith	93-B	AEO	A 128	18" Fluorescent	Bunny	2:30	2:45
2:40	Newton	2-3	MPT	27	1-100 Watt Lamp	Bunny	2:50	3:20

Fill in all spaces — For office use only

WORK ORDER

To: L. M. Blakely SERIAL NO.: 94681

Date: 6/25/45 Account Number: 9 Department: APB Scheduled Completion: 6/30/45 Cross Order:

Building Number: 347 Equipment Number: Direct: ✓ Indirect:

Date Wanted: 6/30/45 Issued by: Montague Card Number: 892 To Department: AWE

Description of Work:

Repack stuffing box, main steam valve, wax storage tank heater line, when job is down Sat. P.M.

Craft	Fitters	Helper											Completed				Actual
Date	6/30	6/30															
Hours	1	1											Date	6/30	Hours	2	2
Labor																	
Material													Sgn.	R.B.	Labor		2 20
Date																	.55
Hours													App.	J.K.	Material		
Labor																	
Material															Total		$2.75

Production Department	Maintenance or Equipment Supervision	Works Engineer	Serial Number
K. E. Trent	C. S. Sherman	L. M. Blakely	94681

Telephone requests for minor maintenance services are entered on the Telephone Orders sheet. Work Orders are made out to authorize jobs that will involve more time and labor

assigning the responsibilities of each group.

The lubrication foreman for the area involved receives these schedules, which are added to his general area schedule, and certain oilers already covering that area are assigned to cover the installation. The production department is also given a schedule covering the parts to be lubricated by its personnel. A sample chart is shown on page 162. One, used by the maintenance group, is checked and returned to the foreman. The other is for the production department's use.

Trouble Reports

Every effort is made to train oilers to report all unusual conditions they observe, such as electrical trouble, pipe leaks, noisy or heating bearings. That is the chief reason for dividing oilers into groups, the group that oils motors being particularly well experienced.

All lubrication supplies are under the jurisdiction of the lubrication engineer, who holds the number of different types to a minimum in order to prevent confusion and minimize storage problems. He determines the amounts to be held in reserve. All such supplies are charged to stores and re-ordered when required as shown by the inventory record cards. Lubricants are requisitioned by area or by group foremen on stores orders as they are needed. In this way the cost is credited to stores and charged to the proper production department.

Elevator Maintenance

Elevator lubrication does not come under the general lubrication set-up. Since there are in operation 34 freight

PLANT REGISTER — MOTOR

Shop Number 98/C Department Stock Building 78 Floor 1 Location

1 H. P. 1130 R. P. M. Full Load 1.69 Amps. per Term. 440 Volts 3 Phase 6 Poles

Make Gen. Elec. Co. Type KT Frame Number 122 Form C Serial Number 1496899

Motor Shaft 1" x 1½" Key ¼" x ⅛" x 1" Pulley 4½" x 2½" x 1"

Drives to 5" x 2" Pulley Running at 1020 R. P. M. Belt x

Starter: Shop Number 3/69 C Make G. E. Type P 102 Serial Number 83191

Fuses: Running, Amp. Type ; Starting Ampere Type

Date Purchased 4-24-18 Purchase Order 26435 U

Date Installed Department Building Floor Date Removed

PLANT REGISTER — MACHINE

Machine Number 7712 | Department ABA | Building 330 Floor 3 | Type Bullet Assembling Machine

H. P. | Operation Bullet Assembly | Manufactured by Waterbury Farrel Fdy & Mach. Co

Floor Space 3'-6" x 3'-9" | Weight 3200 | Pulley 35¼" x 4¼" | Theo. R. P. M. 79 | Spindle | R. P. M.

Counter Shaft 3'-0" x 1⅝" | Hangers 12" J | Theo. R. P. M. 155 | Shipper Brace 32"

Pulleys:—M. Line 15" X 8" | Tight—Loose 20" x 4" | Driver 18" x 4"

Counter Shaft | Hangers | Theo. R. P. M. | Shipper Brace

Pulleys:—M. Line | Tight—Loose | Driver

Main:—Shaft Sw 2 7/16" | Actual R. P. M. 207 | Hangers 15" Cresson

BELT ÷ MAKE

Overhead			Machine			Spindle		
Length	Width	Tension	Length	Width	Tension	Length	Width	Tension
19'-11½"	4" S		16'-9"	4" S				

REMARKS: Equipped with Auto Feeding Hopper - also Wood Feeding Tray 17½" x 17½" x 4"

Plant Register cards for motors and machine contain complete information about the equipment

and passenger elevators, plus numerous hoists and similar equipment, several mechanics do nothing but inspect, service, and repair elevators, and take care of their lubrication. Superficial inspection of all elevators is made daily, and urgent repairs and adjustments are made immediately. Elevator machines are lubricated at the same time these inspections are made.

A thorough inspection of the complete equipment, car, cable, motor, brakes, and all, is made on each elevator once a month, and the elevator inspection form, pages 160 and 161, is forwarded to the supervising engineer who plans any needed repairs.

Immediately after these repairs are finished, an additional thorough inspection is made, with the assistance of the state elevator inspector. Upon receipt of his approval, the elevator in question is restored to the monthly check list. The state inspector renders invaluable service, by his periodic inspections and recommendations.

Building Inspection

Plant buildings are subjected to thoroughgoing inspection once a year, covering foundations, walls, window sills, roof, skylights and monitors, ventilators, roof drains and leaders, outside; and walls, sidewall sash and operating mechanisms, structural elements, floors, stairs, railings, partitions, doors, inside.

In this inspection are also included many items of general service equip-

ment, such as light and power wiring and switches, steam, air, water, oil and gas piping, dust collectors, exhausters, and ductwork.

Sprinkler systems, firedoors, elevators, and all machinery are handled separately; therefore they are excluded from this inspection.

Electrical Inspections

Once a month the load in amperes is measured on each of the 60 main distribution circuits, both 440 and 110 volts, to see they are not overloaded.

Underground cables, ducts, and manholes are carefully inspected once a year. The inspection covers condition of cable hangers, bonding resistance, temperature of the cables, and condition of cable joints.

Thorough inspection of motors is made every six months. The procedure involves measurement of the starting and running current in each phase of polyphase machines, insulation resistance, and temperature. The visual inspection includes such items as need for lubrication and condition of frame, leads, and control.

Power Drives

Mechanical power drive elements —lineshafts, bearings, clutches, belts, belt shifters, and the like—are not the subjects of formal inspection at stated intervals. They are rather under almost continuous observation, since the oilers report immediately all troubles or unusual conditions. Needed repairs and replacements are then made at once.

The same thing is true in general of exhausters, blowers, and unit heaters, although, as mentioned previously, this equipment is examined carefully once a year, during the annual building inspection.

Production Equipment

All production equipment is given a periodic thorough inspection, the longest period being six months between inspections. Equipment that is in continuous operation, of course, is inspected more often. While all equipment for different operations varies to a great extent, the following procedure is typical, and is modified only by the difference in parts encountered in other equipment. The routine of a press inspection is as follows:

Guards, fixtures, and punch block are removed. Frames are washed down and checked for cracks. The gate is barred to check the fit of connections, which will also show up any loose bearings back to and including the main bearing. The fit in the gibs and ways is inspected by a feeler gage. Gate travel is checked by an indicator gage, which, with a different set-up, will also show whether the gate is parallel with the bed.

The flywheel bearing is checked by rocking the wheel. The endnut on the flywheel is loosened and the flywheel partially removed to check the clutch key slot and the backing and driving plugs. Clutch key condition and fit are checked. The condition of the brake then is checked, with attention to the condition of the lining, anchor stud, adjusting screw, tension spring, and releasing mechanism. After necessary repairs and adjustments have been made, the press is then reassembled and the fixtures are aligned by special tools, the whole is inspected, and the guards are replaced.

All lubrication fittings and oil cups are closely inspected while the machine is down to make sure that all wear points are properly lubricated.

Automotive Equipment

There is also recurring servicing in connection with all automotive equipment, but this is a matter of routine with which any car driver is already familiar. It involves daily checks of gas, oil, air, and water; and periodic checks, usually done at lubrication time, of brakes, tires, points, coils, and other parts. Emergency repairs are made as required. Drivers are responsible for their trucks, and must immediately report to their foreman any trouble and damage.

Light and Power

In connection with the light and power circuits, it is fortunate that during this period of 24-hour operation there have been few power failures, and these were entirely local in effect. Before the outbreak of hostilities in Europe it was known that the main underground transmission cables

Close watch is kept on the lighting system and lamps or fluorescent tubes are replaced, and any other needed repairs are made promptly

ELEVATOR INSPECTION

Good Condition (v) Bad Condition (x) Not Equipped (o)

Elevator No.	Date	Machine	Controller	Phase Relay	Motor	Brake	Belt	Sheaves	Car Cable	Cwt. Cable	Ship Cable	Shaft	Term Switch	Limit Switch	Car Guide	Cwt. Guide	Cwt. Shoe	Car Shoe	Car Control	Slack Cable	Speed Gov.	Car Cover	Car Gate
1																							
2	4-2	v	v	v	v	v	o	v	v	v	v	v	o	v	v	v	v	v	v	v	v	v	v
3	4-2	v	v	v	v	v	o	v	v	v	v	v	o	v	v	v	v	v	v	v	v	v	v
4	4-3	x	v	v	v	v	o	v	x	x	v	v	o	v	v	v	v	v	v	v	v	v	v
5																							

Detailed Elevator Inspection reports do much to insure a thoroughgoing examination

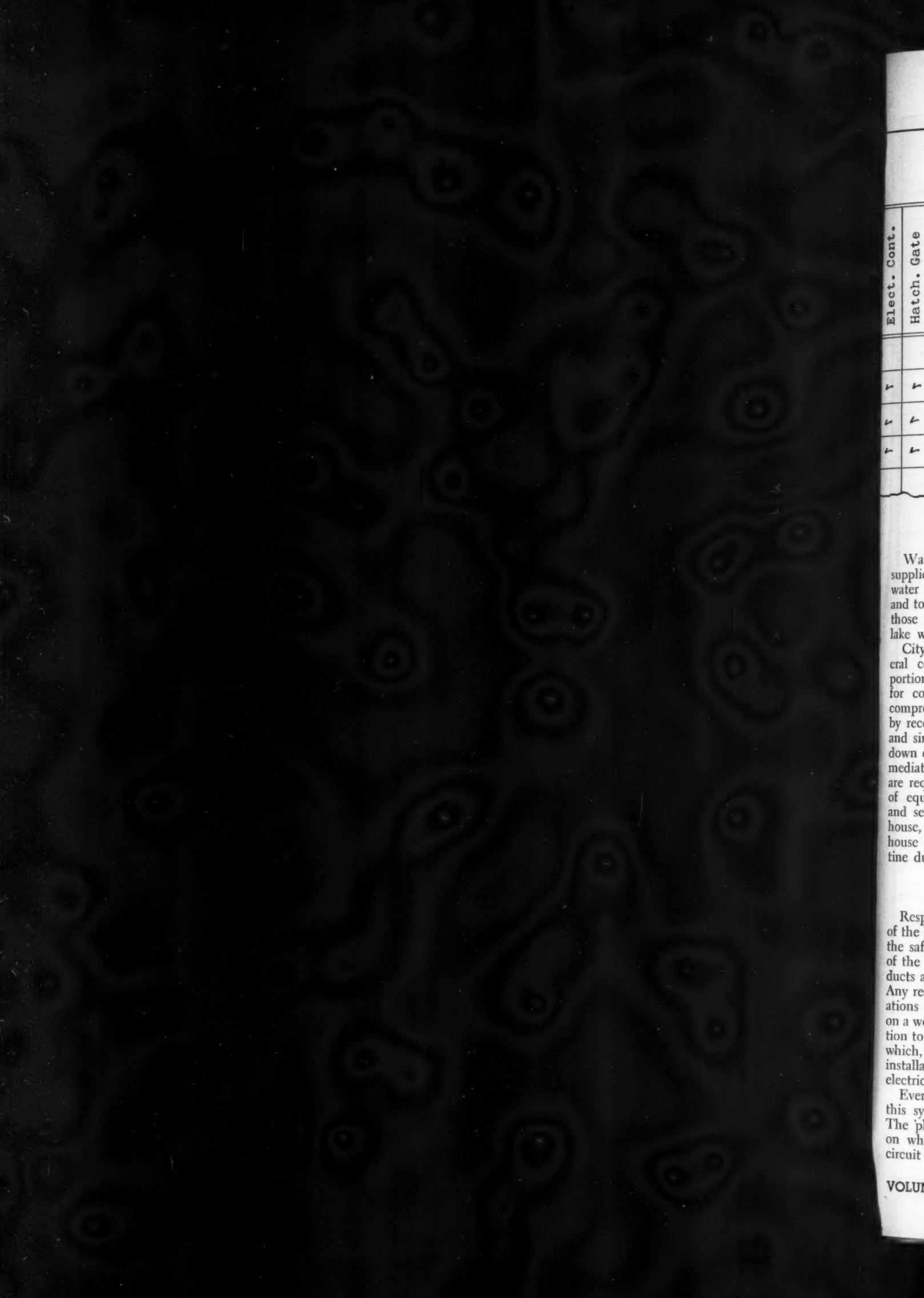
Here the control for a large motor driving an air compressor gets one of the frequent, careful check-ups that insure proper operation

were overloaded and in poor condition, and that transformer capacity was too small for the probable requirements. Therefore the installation of additional transformer capacity and new cables had been completed. This is an excellent example of what can be termed "corrective maintenance." However, freedom from serious power failures can also be credited in part to some preventive maintenance.

Ground Lights

A three-wire ungrounded distribution system is used throughout. (Of course, all equipment, conduit pipe, boxes, and even floors in hazardous areas, are well grounded.) Ground indicating lights are installed on the lead side of each transformer or bank of transformers, both power and light. Should a ground occur on one phase, the ground lights will show it, but there will be no ill effect until an additional ground occurs on another phase. These ground lights are inspected daily. When a ground is indicated, it is traced out during the week, while equipment or lights are kept in operation, and then cleared up at the first opportunity that will not interfere with production.

The few power failures experienced have been due to the attempt to keep operating when a ground was indicated, and a chance was taken to get out needed production. On the occasions when such gambles have been necessary, they have been successful more often than not.


Elect. Cont.
Hatch. Gate

Elect. Cont.	Hatch. Gate	Cont. & Lock	Wiring	Bells	Signs	Pit	Car Gen'l	Date Completed — 4-3-45 Inspected By — A. Logerfeldt REMARKS
✓	✓	✓	✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	✓	✓	✓	Work to start 5-7-45

Utilities

Water for toilets and washrooms is supplied by the lakes in the park. City water is used for drinking, process, and to supply some of the buildings—those that are not connected to the lake water system.

City gas is used for processing. Several compressors located in various portions of the plant supply the needs for compressed air. These gas and compressed air systems are protected by recording instruments, bell alarms, and similar devices so that any breakdown or failure is apparent almost immediately and no regular inspections are required. Since most of this type of equipment that needs inspection and servicing is located in the boiler house, it is taken care of by the boiler house operators as part of their routine duties.

Fire Alarms

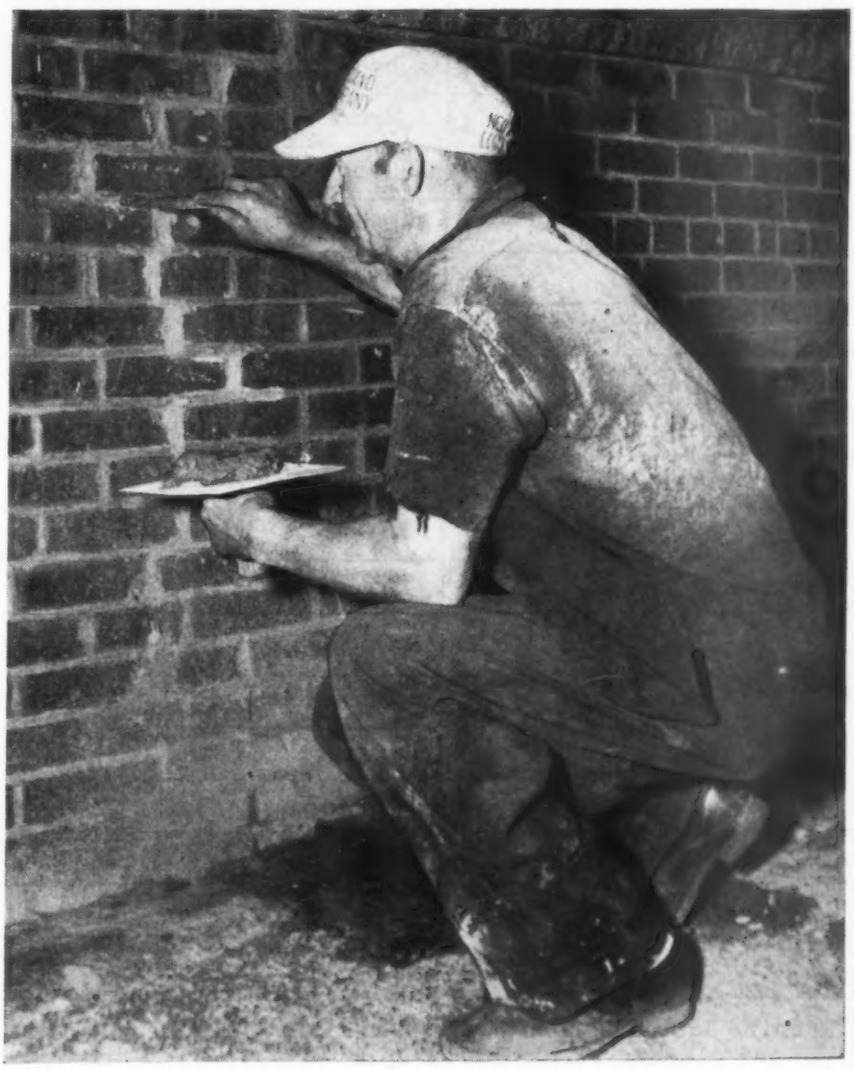
Responsibility for proper condition of the fire protection system rests with the safety and fire protection division of the service department, which conducts all routine tests and inspections. Any required repairs, flushing, or alterations are requested by that division on a work order form. The only exception to this routine is the alarm system which, since it is primarily an electrical installation, is regularly serviced by the electricians.

Every master and section box on this system is tested once a month. The plant is served by three circuits on which are alarm boxes, and one circuit that distributes signals from headquarters to five recorders. Each box circuit is tested once daily, which repeats on all recorders. Since the fire alarm system is self-supervisory, having lights and buzzers that automatically indicate trouble on it, these tests cover the maintenance problem on this equipment.

Job Schedules

The remainder of the maintenance work is done under work orders that form a backlog of work for most of the various craftsmen comprising the maintenance group. From the reports of machine inspectors, maintenance men, and building inspectors, the supervising engineers plan and schedule minor repairs and adjustments during proposed downtime of equipment and departments, and issue work orders.

All of these jobs are scheduled carefully, with due regard for immediate



Pointing open joints in brickwork is one of the many things that must be done systematically in order to keep buildings in good condition

30 CALIBER AREA LUBRICATION SCHEDULE

1st Draw
3 No. 04 Consolidated Machines

Date:_____

Shift:_____

Part	Method of Application	Lubricant	Check Off						
DAILY SCHEDULE "A"			M	T	W	T	F	S	
Main Bearings	3 Hydraulic	A-02							
Upper Connection	1 Hydraulic	A-02							
Gate Gibs	Direct	A-18							
Flywheel	1 Hydraulic	A-02							
Dial Operating Mechanism									
Bevel Gear	Direct	A-08M							
Bevel Gear Shaft	2 Hydraulic	A-02							
Dial Shaft	1 Hydraulic	A-02							
Dial Shaft Bearings	1 Hydraulic	A-02							
Jack Shaft Bearings	1 Hydraulic	A-02							
Main Bearing	1 Hydraulic	A-02							
Idler Pulley	1 Hydraulic	A-02							
Finger Arm	1 Hydraulic	A-02							
Belt Driven Hopper									
Bevel Gear Shaft	1 Hydraulic	A-02							
Bevel Gears	1 Hydraulic	A-08M							
Hopper Paddle Shaft	1 Hydraulic	A-02							
Clutch Key Mechanism									
Clutch Key	Direct	A-18							
SUPPLEMENTAL SCHEDULE "B"									
Finger Arm Cam	Direct	A-08M							
Driving Chains	Direct	A-40H							
Clutch Key Mechanism									
Clutch Key Linkage	Direct	A-18							
Clutch Key Support Shaft	1 Oil Hole	A-18							
SUPPLEMENTAL SCHEDULE "C"									
Machine Nos._____to be wiped and cleaned with mineral spirits									

Shown here is a typical lubrication schedule prepared for the use of the production department

With their power-driven saw and truck, at the left, containing all the tools and supplies that will be needed, these millwrights will make comparatively short work of replacing a trolley conveyor track

necessity, in consultation with general and craft foremen.

In addition to the maintenance department's reports, others covering both buildings and service equipment are turned in regularly by the plant patrol division, and the safety and fire protection division, as well as by so-called foreign inspectors such as the state elevator inspector and the Factory Insurance Association inspector, who make periodic inspections and tests of certain equipment.

Finally, production supervisors and the technical department consult with and inform the supervising engineers of desirable improvements in equipment and process, and work out with them the necessary equipment changes to produce the desired results.

Corrective Maintenance

At Remington Arms it is considered that corrective maintenance starts where preventive maintenance leaves off. All the records, work orders, suggestions, and reports mentioned previously are subjected to further study by the supervising engineers. Those items of production or service equipment, or portions of buildings or grounds, that appear often on the work orders, or that are the subject of special recommendation, are considered from the point of view of redesign, replacement, or general overhaul. This also applies to items in the general inspection reports that show appreciable deterioration or wear.

A complete study including plans, drawings, specifications where necessary, cost estimate, estimates of return on investment, description of necessity, and ends to be accomplished is prepared and turned over to the project section for the preparation of a project. Whether or not the work should be done is passed upon directly by management.

Upon proper authorization, the supervising engineer becomes responsible for the speedy completion of the projected work.

This corrective maintenance program is reviewed every three months by the supervising engineers and works engineer, and also in plant staff meetings, by means of a construction forecast prepared quarterly by the project section. Included in this forecast are both authorized and proposed projects, properly differentiated. The project section also keeps the supervising engineer informed as to costs compared with the estimates of each authorized project.

Continuity of Production

While all emergency repairs and breakdowns, and all maintenance classed as preventive, are and have been done solely by the plant's own forces, it has not been possible to take care of the larger items of corrective maintenance without outside assistance. For the past several years the maintenance department has had to supply coverage to the plant on a two- and three-shift basis, with a limited number of trained craftsmen. However, it so happens that several of the local general contractors, outside machine shops, and specialty contractors have built up a splendid reputation for quality of workmanship and cooperation during this time. It is hoped that, upon the return of more normal operation, even better results can be obtained by the extended use of the plant's own trained personnel. But regardless of who does the job, the maintenance department does its best to live up to its creed, "Production must go on!"

TO INSURE LOW-COST PRODUCTION 10 Provide

Case of Dravo Corporation

PHILIP H. KLINE
Assistant to Administrative Manager
Dravo Corporation
Wilmington, Del.

FOR THE PAST THREE YEARS a group of engineering-trained personnel, organized into what is known as the administrative control department, have been doing the "legwork" for top management executives at the Dravo Corporation's Wilmington shipyard, thereby providing them with the kind of information they have needed in order to maintain wartime schedules—and will need more than ever in the reconversion era if they are to produce at low unit costs.

For many years the Dravo-Wilmington shipyard had served effectively as an assembly and erection point for the Eastern seaboard, to deliver lighters and barges, drydocks, caissons, and other heavy engineering works such as floating cranes and dredges. The expansion of plant facilities in 1942 called for an increase in the number of employees from 450 to nearly 11,000. Combat and work vessels for the Navy and Army were then to be fabricated, assembled, and outfitted by production-line methods which had been developed before the war at the Neville Island home plant near Pittsburgh.

Soon after the large-scale operations had been started, the War Manpower Commission classified the local area as a No. 1 labor market. Also, material was becoming increasingly difficult to obtain. Yet the production of completed ships was needed *as soon as possible* for our armed forces. The vice-president and the general manager at Wilmington were thus faced with innumerable problems of planning, organizing, and developing management matters of current necessity and of far-reaching importance.

Much-Needed Assistance for Top Management

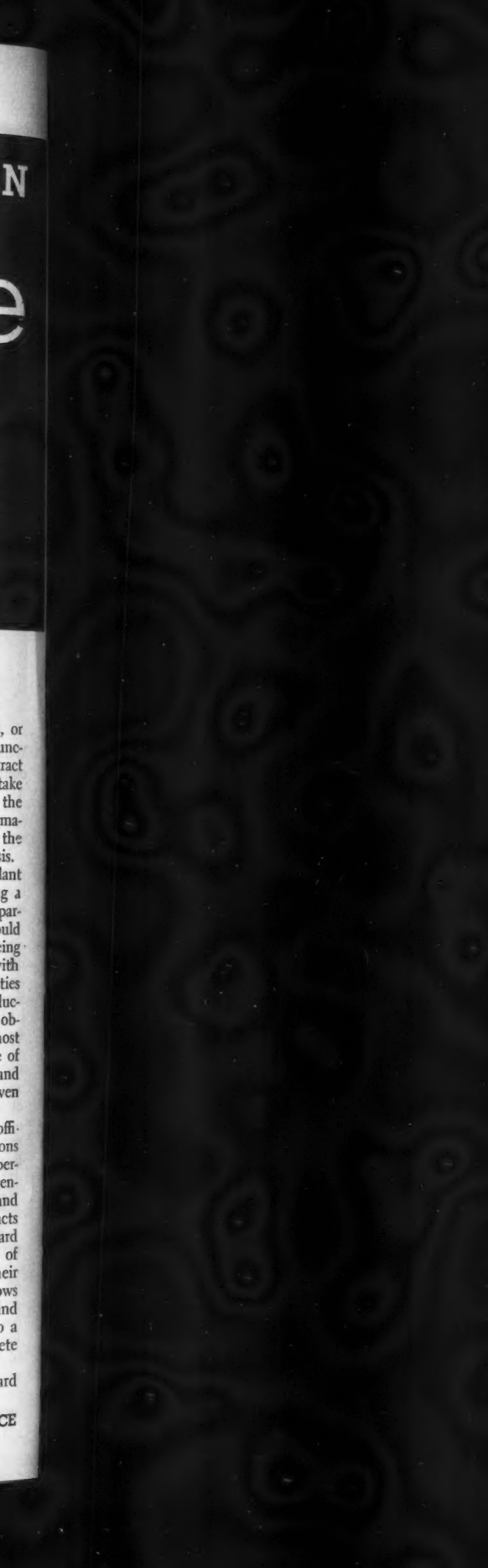
This article describes some of the assistance given to top management executives and points to the value of adapting such methods to other changing conditions, which always seem to be occurring in both present and future operations.

The administrative control department was organized with the responsibility of quickly assimilating and reporting on the highlights of the plant program, and of being prepared to collaborate intelligently where required on any "bottleneck" assignment. This group could not consider in detail the maze of design drawings, shop bills, purchasing and inventory controls, or other technical and specialized functions such as accounting and contract arrangements. But it could undertake assignments of coordination and the development of most needed information in order to get some of the urgent "answers" on a working basis.

A practical background of plant operations was obtained by making a daily visit to all activities and preparing a summary report which would show evidence of the coverage being obtained and the soundness with which it was developed. All facilities installation was watched, and production methods and difficulties were observed. Within a short time most major aspects of the program were of first-hand practical knowledge, and some special problems were given needed attention.

By wholesome discussions with officials of other plants and organizations within industry, and by similar cooperation from related government agencies, additional data on trends and policies were obtained. Such contacts provided intelligent direction toward the investigation and presentation of pertinent facts and assisted in their proper interpretation. Figure 1 shows the first "Daily Status Report," and Figure 2 its final development into a formalized "Daily Log" of complete current and historic control.

The Daily Log is now a standard



Management Controls

compilation of various departmental reports issued in complete hectographed sets to eight top plant executives and to the office of the president of the corporation. It has replaced many odd-sized and inadequate forms, and yet is flexible and complete. Other sheets from the Daily Log are shown in Figures 3, 4, and 5.

A partial list of reports is shown herewith. There are also reports from inspection, engineering, industrial relations, and purchasing departments. However, at weekly, monthly, or other intervals, additional contents of similar style but varying information are included as needed. All individual pages are dated and reproduced as soon as compiled, and certain sheets that are valuable to various departments as a separate, more urgent, report are distributed singly as needed.

Chronological Record Provided

In order to provide a chronological record of each subject covered in the Log, the page originals are designed to be retained by the department preparing the data. All notations and summary data pertinent to that work are retained in these master volumes so that an authentic conclusive file can be produced as needed. All detail concerning the reports is the responsibility of the "Department Reporting" as shown in the lower corner of the sheets. Thus the Log was essentially a departmental record, but has become an administrative control.

Among the early controls needed by management was the clarification and expansion of plant occupations terminology and the establishment of a new wage-rate schedule. All present and probable future job descriptions were outlined tentatively to insure consistency and to define the limits of skill and the scope of activities of the various jobs.

From this information it was possible, as early as September, 1942, to plan for the use of women in the plant, which had employed no women production workers prior to that time. Estimates made from the preliminary survey were within 10 percent of actual 1944 figures, although there were overages and unders in certain occupations and departments. (The deficits

MANAGEMENT CONTROL REPORTS

A Partial List of Typical Subjects Covered

Issued by Administrative Control Department
April, 1943 – November, 1944

- Summary of Daily Log—1943
- Special Report on Production Terminations & Absenteeism
- Utilization of Cafeterias
- Review of Shift Absenteeism
- Six Months' Review—"E" Award
- Manpower Distribution
- Sample Launching Arrangements
- Analysis of Office Employees Force and Roll Data
- War Production Board Report
- Man-Hours Lost—Work Stoppage
- July 4th Attendance Analysis
- Six Months' Turnover
- Survey—Leave of Absences
- Incentive System Summary

DRAVO CORPORATION
WILMINGTON YARD

DAILY STATUS

DATE *Wed. 12/9/42*
WEATHER *Clear - Cold*

R.R. CARS

No. unloaded yesterday ___ *3*
In R.R. yard for spotting ____ *2*
In our yard for unloading ____ *1*
Enroute from mills _____ *4*
TOTAL *7*

FORCE BY SHEETS

		1st	2nd	3rd	TOTAL
Tues	No. Yard	*2000*	*1000*	*800*	*3800*
12/8/42	So. Yard	*428*	*100*	*72*	*600*
	TOTAL	*2428*	*1100*	*872*	*4400*

FORCE WORKING BY LOCATION AND OPERATION

DATE	*TUESDAY 12/8/42*				*MONDAY - 12/7/42*			
LOCATION	No. Yd.	So. Yd.	Other	TOTAL	No. Yd.	So. Yd.	Other	TOTAL
Erection	*2350*	*290*	—	*2640*	*757*	*519*	*119*	*1395*
Outfitting	*1025*	*110*	—	*1135*	*1197*	*37*	*9*	*1243*
Training	*125*	*70*	—	*195*	*500*	*46*	*64*	*610*
Labor	*300*	*130*		*430*	—	—	—	—
Salary	—	—	—	—	—	—	—	*555*
TOTAL	*3800*	*600*	—	*4400*	*2454*	*602*	*192*	*3803*

HULL NO.	*NOTES*
Cont 1447	*— Trim up to deliver*
2020	*— Sleds set to launch*
2012	*— Weld hull*
2013	*— Start erect superstructure*
2014	*— No work*
2015-16	*— Preassembly .*
Cont. 1495	*— Preassemble*
	Held up for material
Cont. 1496	*Preassembly rake ends*
2179	*Crane mchy. received*
2180	*— Waiting for bulkheads*
2181	*— Preassembly and erection*
Cont. 1484	** Note below*

16 — Propellers - Deckhouse - Press Br.
21 — Lower stern 40% preassembly
25 — Deckhouse 10% preassembly

FACILITIES CONSTRUCTION :-

	1st Shift	2nd Shift	3rd Shift	TOTAL	PREVIOUS DAY-TOTAL
Sub-Contractor A	*100*	*80*	*75*	*255*	*270*
Sub-Contractor B	*2100*	*900*	*300*	*3300*	*3410*
Sub-Contractor C	*10*	—	—	*10*	*15*
Sub-Contractor D	*60*	*60*	*50*	*170*	*210*
TOTAL	*2270*	*1040*	*425*	*3735*	*3905*

Framing N-13 - 2nd floor addition
Erect. N-24 - Columns
Crane rails - 2nd line set
Installing collections
Framing N-6 - Cols. and trusses

Unloading riprap
Caps and braces to Sta. 9
Backfill to Sta. 3 and 50
Driving fender piles

** Hull No. 10 to move to new mooring Friday 12/11*

COPIES TO:- *Plt. Engr. - Genl Mgr.*

SUBMITTED BY *12/9 11⁴⁰ AM*

Figures 1 (above) and 2 (see opposite page) illustrate the development of a daily report to top executives . . .

DAILY LOG

DRAVO CORPORATION
WILMINGTON, DELAWARE

IN CHARGE

NAME	TITLE
R. W. REMP	VICE-PRESIDENT
P. M. O'LAUGHLIN	GENERAL MANAGER
D. McDONALD	ASS'T. SECTY. & ASS'T TREAS.
COMDR. S. M. ALEXANDER, U.S.N.	SUPVR. SHIPBUILDING U.S.N.
COMDR. F. R. BLOOMBURG, U.S.N.R.	NAVY COST INSPECTOR

NOTES ON EVENTS, INCIDENTS, ORGANIZATION

Vessel 226 departed at 0945, September 30, 1944
Vessel 230 was launched at 1102, September 30, 1944
Vessel 227 is out on trial trip today

Visitors:

Mr. A. B. Brown, XYZ R.R. re inspection - Mr. Green
Mrs. Emily Stone, W.F.A. re cafeteria - Miss Cowley

Future

Plans were started for community drive in collaboration with Morale and Recreation Department

PREPARED BY	DATE	DEPARTMENT REPORTING
H. Graham	10-1-44	Administrative Control

CONTENTS

SUBJECT	PAGE	SUBJECT	PAGE	SUBJECT	PAGE
Special Notes	1	Daily Hiring	9	Work Done	17
Meteorological Report	2	Term Accumulations	10		18
Summary Roll & Absentees	3	Daily Terminations	11		19
Roll & Absentees, Wage	4	Training Program	12		20
Roll & Absentees, Salary	5	Accident Report	13		21
Electric Welder Force	6	Operations Schedule	14		22
Daily Force Report	7	Hull Locations	15		23
Hiring Accumulations	8	Work Done	16	Sunday Forecast	24

The information contained in this report is solely for the day to day general guidance of management in the conduct of the affairs of the yard. It is in no particular accurate enough to be used as a conclusive record.

Philip D. Kline

ISSUE NO. 274-44 — SATURDAY 9-30-44 DATE — PAGE NO. 1

... from the rough sketch report originally used by Dravo Corporation to its present formalized "Daily Log"

CONTINUED ON NEXT PAGE

were sometimes due not to improper job analysis but to personalities involved in supervision and training.)

Delivery schedules and estimates of production manpower demands were used to chart departmental staffing and expected over-all plant efficiencies. Advance data were prepared which exceeded, for useful management value, the detailed requirements of the Selective Service manning tables. Replacement tables adequately supported by labor and training demands were ready in December, 1942, among the earliest prepared in the Atlantic Coast Zone for this industry.

A typical planning sheet is shown in Figure 3, which treats acetylene welders as an occupation, Code 04. (All occupations were coded by a block decimal system which showed related groups, classification within the trade, and identification of the rate group. For instances, all second-class welders were coded 042 and second-class carpenters 352. Helpers in all crafts had a third digit of —6; handymen —5, etc. Later a four-digit system was used which included the last two numbers of an hourly rate. Thus a $1.18 welder could be coded 0418 and a $1.11 carpenter could be 3511. Since the rate scale did not exceed a range of from 60 cents to $1.59 per hour, base time, all third and fourth digits in the codes were self-explanatory without using the dollar sign.)

Labor Needs for Two Years Shown

Preceding the "Replacement Analysis" shown, a two-year forecast was made showing each department's occupational requirements and the present number of workers on hand (liable and not liable to the draft), all by classification of workers. The total hiring load proved to be so large that priorities were given certain crafts depending on training time estimates. Trainees were then entered as recruited or assigned from regular monthly hires.

In the example shown (see Figure 3) 15 non-experienced persons were scheduled to start acetylene-welder training each month from February through October, 1943. It was estimated that there would be, generally, 60 percent survivors after three months, leaving nine each month to proceed with the remaining training to qualify for the lowest classification.

Such progression through training, third and second class to first class workers is shown by the diagonal advancement of each group of 15, starting from the zero training month (see column at left). Across the chart, calendar-time elapsed is shown. The downward positions show expected classification improvement. Balances were struck from each group of nine to fill out the final required number of workers in a particular classification.

Figure 3. Replacement tables, adequately supported by labor and training demands, were among the earliest exhibits prepared for top management's information. Advancement of acetylene welders was charted here according to needs. Recapitulations of all occupations and departments showed staffing possibilities

DRAVO CORPORATION
Wilmington, Del.

Number

		1942	
MONTHS		N	D
		(1)	
	0	–	–
	1		
Trainees	2		
	3		
	4		
	5		
	6		
	7	7	
	8		6
3rd Class	9		
7—On Hand	10		
35—Required	11		
	12		
	13	3	
2nd Class	14		3
3—On Hand	15		
25—Required	16		
	17		
	18		
	19	2	
1st Class	20		2
2—On Hand	21		
30—Required	22		
	23		
	24		
	25		

With planning so well evidenced, it was possible to show Selective Service officials just how many skilled workers were needed to meet schedules and production manpower requirements. Such tables are applicable for any controlled personnel study, adapting them for scheduling, recruitment, training, etc., including consideration of normal turnover. Adjustment of craft loads because of changes in the production program also can faithfully reflected by means of similar analysis forms.

The important feature of any detailed treatment is the fact that data are tied down to actual plant terms which can be consistently manipulated for fluctuating conditions. It is also to be observed that searching information of this type will reveal the need for action on other management matters such as basic operating definitions, revision of schedules or manhour estimates, re-engineering of processes—even, perhaps, new legal or industrial relations concepts or organization changes.

Management Control Reports Prepared

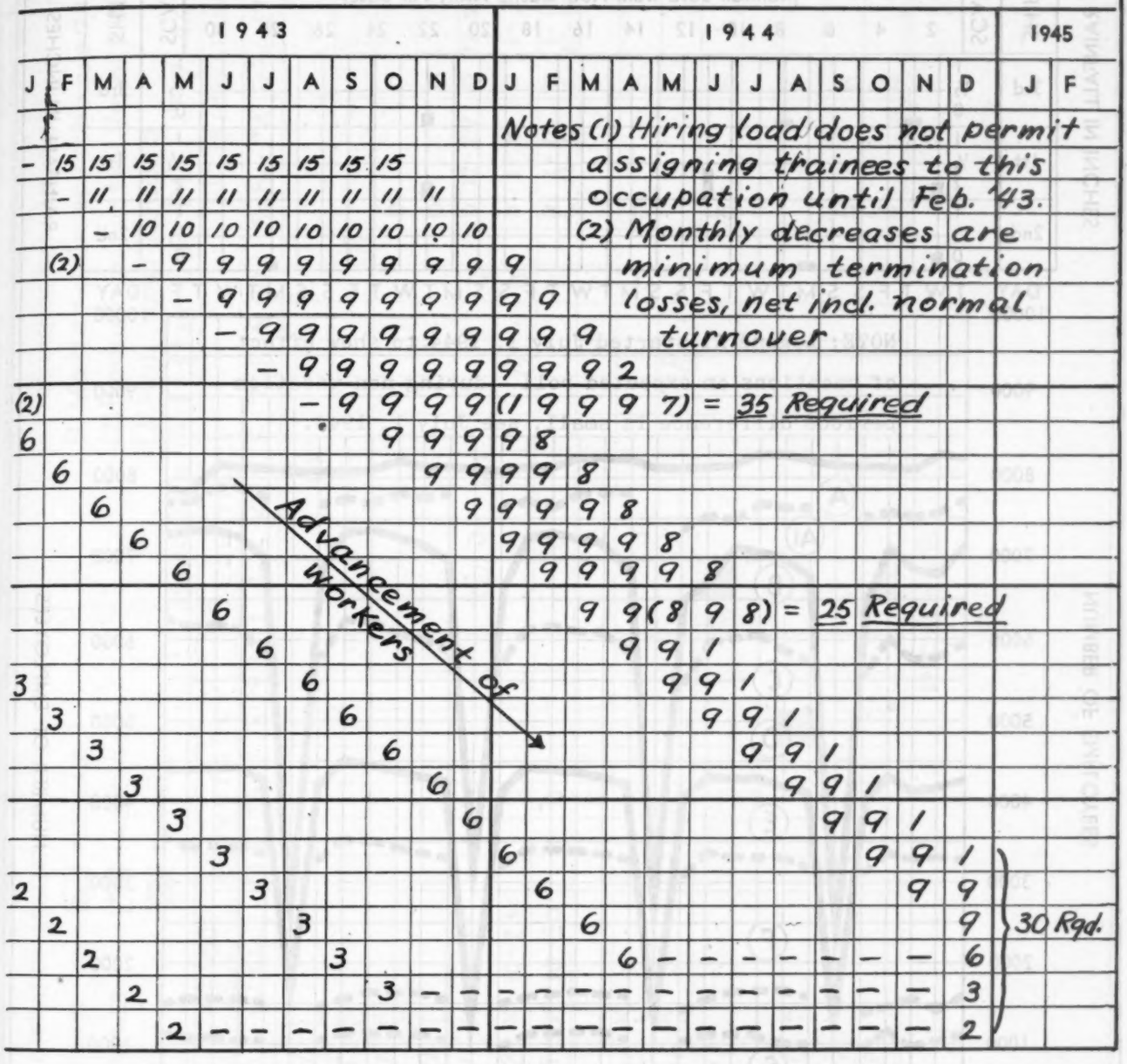
As the plant grew, it became increasingly important that standard nomenclature for operating groups be established. From a one-department yard, more than 60 distinct functional organizations were delineated. Through this departmentalization, many phases of employee and operating references were controlled, including plant statistics of all types. By a digit reference system of organization identification, tabulating machine recording and summarization was possible in the fields of production, personnel, timekeeping, safety, property and fiscal accounting, and others. It was also found that additions and deletions in the yard pattern could be meaningfully applied by block numbering the departmental groups and their various subdivisions.

In order to present particulars for quick management decision and for use as recurrent conference reference, basic definitions and summary reports were developed. Numerous charts, tables, and special analyses were devised for periodic or special occasions, and a series of "Management Control Reports" was prepared.

These reports (see list on page 165) deal only with local plant and industry problems. Outside references are used when applicable, and ample appendices and exhibits are included.

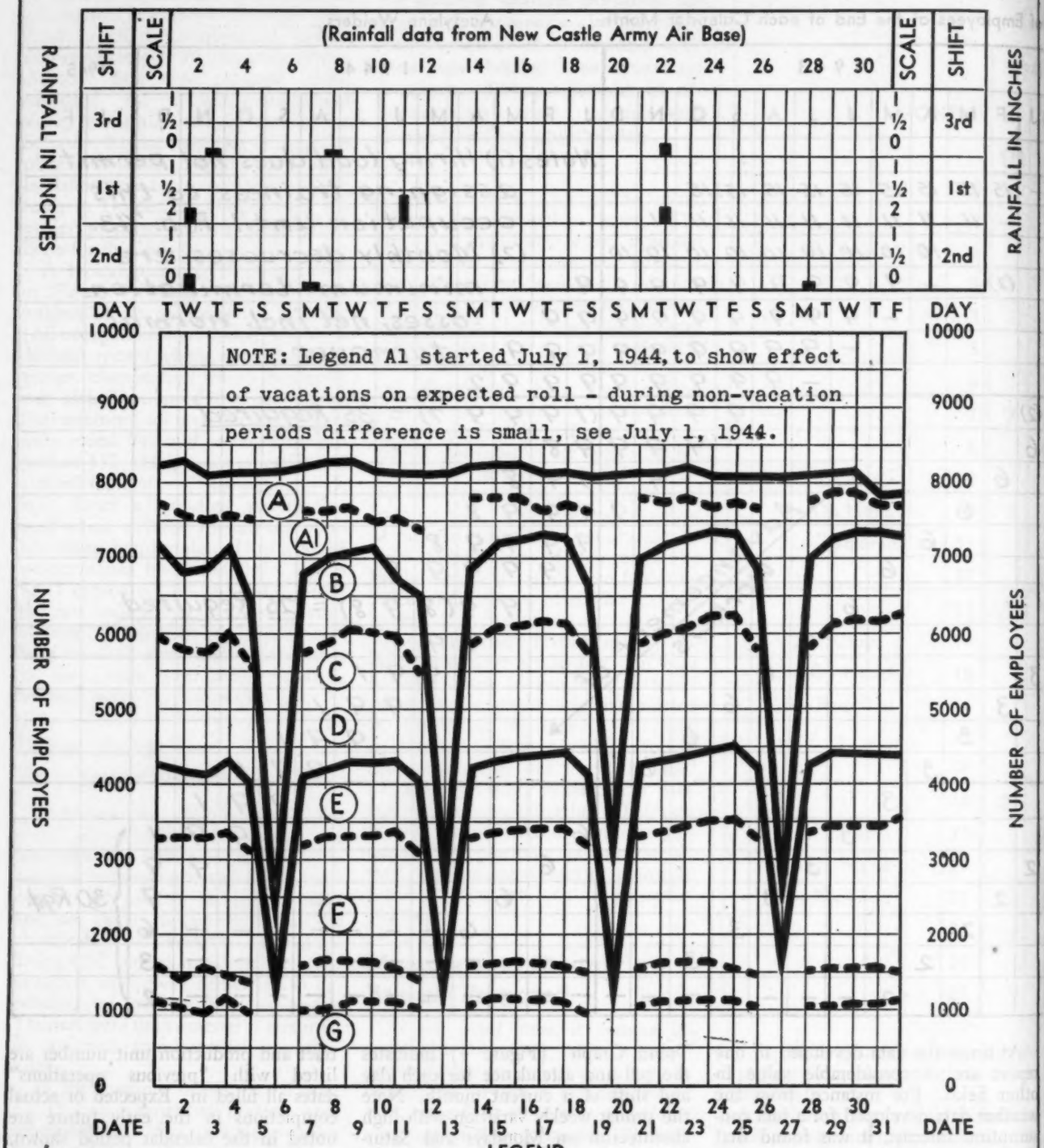
SELECTIVE SERVICE REPLACEMENT ANALYSIS

of Employees at the End of each Calendar Month..... Acetylene Welders.....


1943
1944
1945
J F M A M J J A S O N D J F M A M J J A S O N D J F
Notes (1) Hiring load does not permit assigning trainees to this occupation until Feb. '43.
(2) Monthly decreases are minimum termination losses, net incl. normal turnover
Advancement of Workers
(2) 6 6 3 3 2 2
9 9 9

DRAVO CORPORATION
Wilmington Yard

DAILY FORCE TREND GRAPH



LEGEND

A—TOTAL ROLL
B—TOTAL FORCE WORKING
C—TOTAL HOURLY WORKING
D—TOTAL FIRST SHIFT
E—HOURLY FIRST SHIFT
F—HOURLY SECOND SHIFT
G—HOURLY THIRD SHIFT

MONTH OF AUGUST 1944

The information contained in this report is solely for the day to day general guidance of management in the conduct of the affairs of the yard. It is in no particular accurate enough to be used as a conclusive record.

PREPARED
Ethel Bair - 9/5/44
(By) (Date)
DEPARTMENT REPORTING
Time Keeping

DAILY LOG
FOR September 2, 1944
ISSUE NO. 246-44
PAGE NO. 21

Figures 4 (above) and 5 (opposite page) are typical reports from the "Daily Log." One shows employment...

RAINFALL IN INCHES

NUMBER OF EMPLOYEES

DRAVO CORPORATION
Wilmington Yard

OPERATIONS SCHEDULE

REFERENCE DATA LEGEND
(1) Master delivery schedule 12/1/44
(2) Production Control Report 11/30
(3) Hull Yard Record
(4) Letter CBL-RDC 12-2-44
Issue Date 12-2-44

OPERATION LEGEND
K – KEEL TO BE LAID
L – TO BE LAUNCHED
D – TO DEPART
KEEL LAID
LAUNCHED
DEPARTED

CONTRACT NO.	HULL NO.	PREVIOUS OPERATIONS (ACTUAL)	November 24	25	26	27	28	29	30	December 1	2	3	4	5	6	7	8	9	10	11	FUTURE OPERATIONS Sched "A"	Sched "B"
1539	417	K L												D (1)							—	—
	418	K L																		D (1)	—	—
	419	K L																			D	D
	420	K L																			D	D
	421	K-10-17									L (2)			L (4)							D 12-29	D 12-22
	422	K-10-23															L (2)				D 1-8	D 1-3
	423	K-10-30																			D 1-15 L 12-15	D 1-10 L 12-11
1541	2305	K L																			D	D
	2306	K L																R (1)				
	2307	—								K (3)											L D	L D
1554	2310	K L																			—	—
	2367	K																			L D	L D
	2368	—																			L D	L D

SPECIAL NOTES

DAILY LOG
FOR 12-4-44
ISSUE NO. —
PAGE NO. 14

The information contained in this report is solely for the day to day general guidance of management in the conduct of the affairs of the yard. It is in no particular accurate enough to be used as a conclusive record.

DATE PREPARED 12-4-44
PREPARED BY R D C
DEPARTMENT REPORTING Production Control

... whereas the other gives top management a quick picture in considerable detail of major current operations

CONTIUUED ON NEXT PAGE

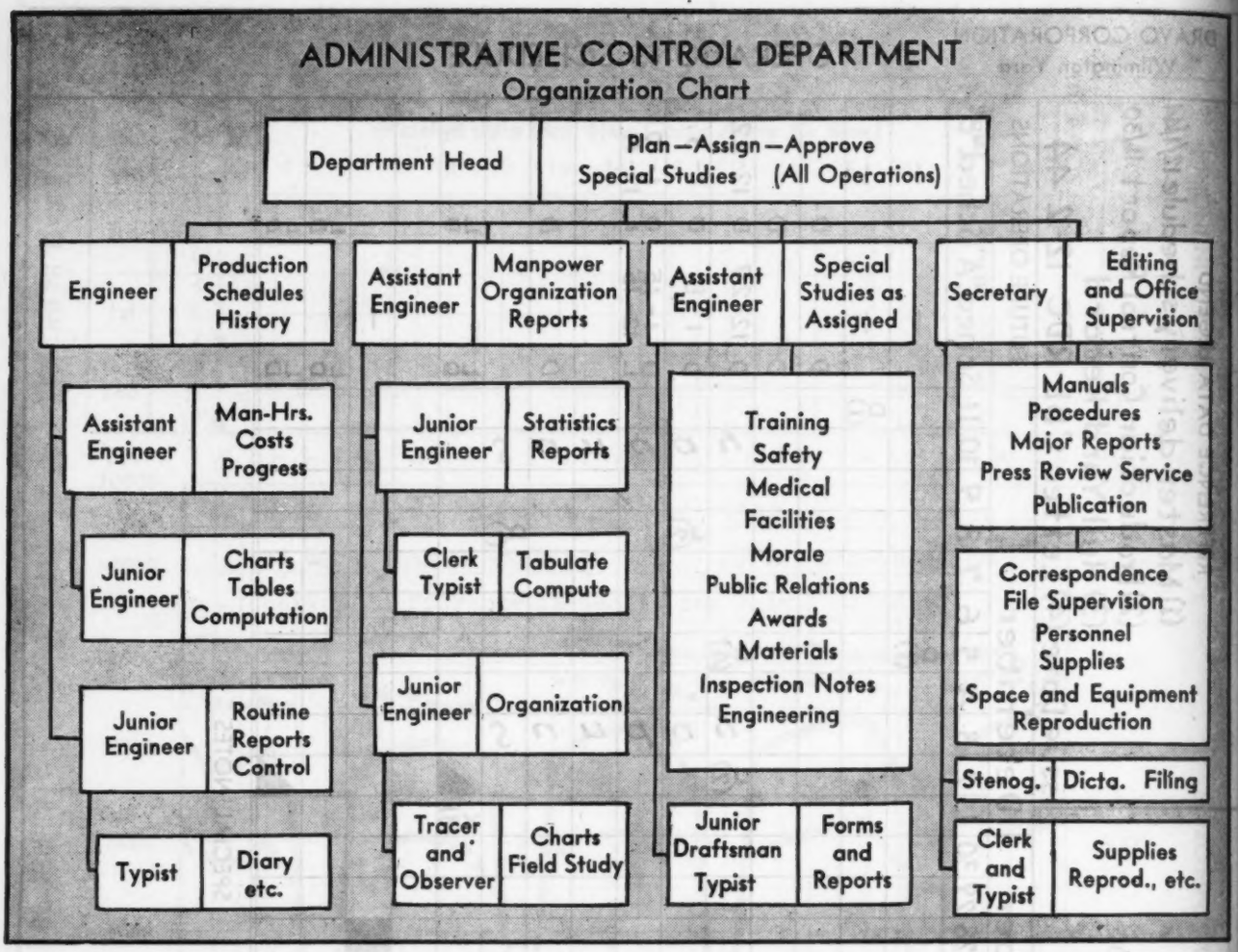


Figure 6. Organization chart of department set up to supply special information to top management

available when they are so maintained.

The above and similar statistical information collected and presented in summary or chronological form has other varied applications. The vice-president in charge of contract renegotiations requested and was forwarded such completed data for one year's operations. When it was necessary to make reviews for morale awards or to provide important press releases, such material was in good order and was administratively correct for use where consistency and executive control required utmost integrity. Practically all the information needed for a comprehensive plant utilization survey can be provided from the routine and special data.

To perform such services as mentioned herein, a group of engineering trained personnel and assistants were selected from experience or aptitude qualifications (see Figure 6). Initiative, ability under pressure, quick grasp of new and complicated problems, and the personality to work together and with all plant groups, were among the chief requirements.

All features of work handled by the department are on the basis of specific assignments given for each item by the three top-ranking plant officials. Brief and general instructions are outlined orally from conference meetings with the operating personnel concerned. After making preliminary checks and getting further instructions if needed, the department head makes all major contacts necessary and outlines the approach to each problem. Development is then worked out with those concerned to secure policy and procedure agreement, or, in the case of statistics, to check on all possible sources of factual knowledge and qualifying conditions.

As a rule it is not considered advisable for any administrative personnel to compile detail data from other departments' records, or to carry on functional routines. However, in some instances, part or all of the department is delegated to work of unusual urgency or to prepare a particular assignment for top company officials or outside use. In most cases, assistant or junior engineers are able to secure special summary data or system-flow information by working with personnel at similar job levels at the particular source concerned.

It has been gratifying to note that plant department heads are anxious to cooperate and to assist in achieving and using the results of the over-all studies. Since only top management officials authorize the issue of broad control information, their review and approval are more than perfunctory. It is important that studies being made and records being kept be thoroughly in accord with management needs. As wartime operations subside, it will be more and more essential that organizations and procedures be adjusted in keeping with company requirements. Some control assistance will be needed. Any control that is not used is of no value except perhaps to the compiler. But, by having matters presented in meaningful summarized and analyzed form, top executives can keep abreast of many factors affecting the whole plant management from day to day and from year to year, in short—they will have real management control.

FREIGHT RATES *and* INDUSTRY LOCATION

A SIGNIFICANT decision, announced by the Interstate Commerce Commission last May, will take preliminary effect on the 30th of August. It will eliminate some of the advantage in freight rates which Eastern shippers have enjoyed over shippers of the South and West.

The decision has been enthusiastically hailed as an Emancipation Proclamation for industrial development in the South and West. It has also been roundly condemned as a meddlesome control measure that ignores valid differences in haulage costs, and recklessly blots out one of the important factors in determining the location of American industry.

Cooler appraisals indicate that the net effect of the rate changes will be far less drastic than predicted by the more passionate advocates or adversaries. Nonetheless, it is important for the business world to be informed both upon the principle at issue, and upon the forseeable consequences of the ICC ruling.

What The Decision Calls For

The Commission's order, unless modified, or successfully contested in the courts, will require: (1) the eventual establishment of a single freight classification, or grouping of commodities for rate-making purposes, for application throughout the United States; (2) a single level of *"class rates"*—or rates established for groups of commodities and primarily applying to manufactured and semi-manufactured articles of high value—in the area east of the Rocky Mountains. This level is to be about 15 per cent higher than the present Eastern scale.

Because it will take some time, probably several years, to work out a uniform classification in place of the three major classifications now existing, a preliminary adjustment is provided.

Under this adjustment the existing classifications will remain in effect, but the rates on articles moving on *class rates* will be increased 10 per cent in Eastern or Official Territory—the area east of Lake Michigan and the Mississippi River and north of the Ohio River. On the other hand, the rates will be reduced 10 per cent on articles moving on class rates in the South and West, and on those moving interterritorially.

What The Problem Was

At the present time there are marked differences in the levels of the basic scales of class rates in the five major rate territories—Eastern or Official, Southern, Western Trunk-Line, Southwestern, and Mountain-Pacific. It is difficult to average the levels of rates, but if the level of the class-rate scale in Official Territory is taken as 100, the levels in the other territories may be roughly considered as follows: Southern, 139; Western Trunk-Line, 128, 146, 161, 184 in Zones I, II, III, and IV, respectively; Southwestern, 161; Mountain-Pacific, 166.

These are over-all comparisons. On many individual articles the differences in levels of rates are greater or less than indicated because of offsetting differences in regional classification schemes. In many cases, the use of exceptions to the classifications and of special commodity rates has reduced the regional disparity in rates. In fact, on some articles, particularly on certain low-grade traffic such as logs, pulpwood, bricks, coal, sand and gravel, the South and the West have actually had lower rates than Official Territory. The rate disadvantage of the South and West has been principally on manufactured articles.

The territorial differences in class-rate levels have complicated the problem of constructing rates from a point in one territory to a point in another. Today, such a rate tends to represent a blend of the levels in effect at the place of shipment and at the destination. Thus manufacturers and dealers in a higher-rated territory are likely to see themselves at a disadvantage when they attempt to sell goods in a lower-rated territory against competition located there.

Now, if differences between territorial rate levels are removed, the *inter*territorial freight-rate problem largely disappears. So it is an important question whether such differences are justified. The Commission has found that they are *not* justified either by differences in transportation costs or by

other valid considerations. From that finding came the order to establish a uniform level of class rates and a single freight classification.

The Decision And The Map Of Industry

What effect will this decision have on the location of industry in the United States; and what effect will it have on the economic development of the East, the South, and the West?

Today, many in the West and South believe that their higher class rates have seriously retarded the industrial development of these areas, and promoted the concentration of manufacturing in Official Territory. They point out that Official Territory has over 50 per cent of the population of the country, had nearly 70 per cent of the persons employed in manufacturing in 1940, and accounted for nearly 73 per cent of the "value added by manufacture" in 1939. Boasts of industrial development in the South, and to some extent in the West, in recent years are accompanied by claims that this would have been greater but for the freight rate structure.

Another point gets into the argument. Official Territory is not only the country's most highly industrialized section, but also its greatest consuming territory. It is the market which nearly all manufacturers desire to reach, particularly when they have a surplus to sell. Here again is occasion for an outcry by producers outside of Official Territory against the consequences of their high rate levels and the levels of interterritorial rates. Under the circumstances it is not strange that the South and West have argued long and volubly for mile-for-mile equality in rates.

Those in Official Territory deny that the South and West have been handicapped by the rate adjustment, but at the same time look with apprehension at the loss of their rate advantage.

What's The Effect?

However, now that the ICC's ruling is about to be put in operation, it is time for the colorful statements of the debating period to give way to a sober appraisal of what the consequences are likely to be.

In the first place, it should be noted that the preliminary adjustment will affect only a small fraction of the traffic. Estimates indicate that only about 4 per cent of the full-carload traffic moves on regular class rates. About 11 per cent moves on exception ratings which are not affected by the preliminary order; and about 85 per cent moves on commodity rates, which were not within the scope of the Commission's decision. The proportion of less-than-carload lot traffic affected is much greater, since a large part of it moves on class rates; however, less-than-carload traffic constitutes less than 1½ per cent of the total tons carried.

The permanent rate structure will probably affect more traffic than the preliminary order since, in the establishment of a uniform classification containing more classes than at present provided, many articles now moving on exception ratings are likely to be brought within the scope of the classification, and the same may be true of some articles moving on commodity rates.

But, even if a large proportion of the traffic were affected by the Commission's order, or if the principle of equality in rate levels is eventually extended to much of the traffic moving on commodity rates, these freight-rate adjustments cannot be expected to revolutionize the pattern of industrial location in the United States.

It seems evident that most industries now found in Official Territory are located there for other advantages than that of a lower level of freight rates, undeniable as such an advantage is. Insofar as that is the case, they have little to fear from equalization of the rate levels. For those which have, indeed, been dependent upon preferential rates and otherwise badly located, the removal of the preference and their consequent shift to some area possessing a real locational advantage would be desirable from the point of view of the national economy.

While the high degree of industrial concentration in Official Territory does not rest on such a flimsy basis as a lower level of class rates, the Commission's decision does remove one existing handicap to the growth and development of the South and West. The new adjustment should permit all sections of the country to develop the industries for which they have natural advantages. It should contribute to a sounder regional specialization than we have heretofore had.

This decision will neither destroy the economy of the industrial East, nor will it, overnight, assure the industrial flowering of the South and West. It constitutes one sound step toward establishing that equality of opportunity for all sections of the country which is essential to a nation that bears the proud title of The *United* States.

President, McGraw-Hill Publishing Co., Inc.

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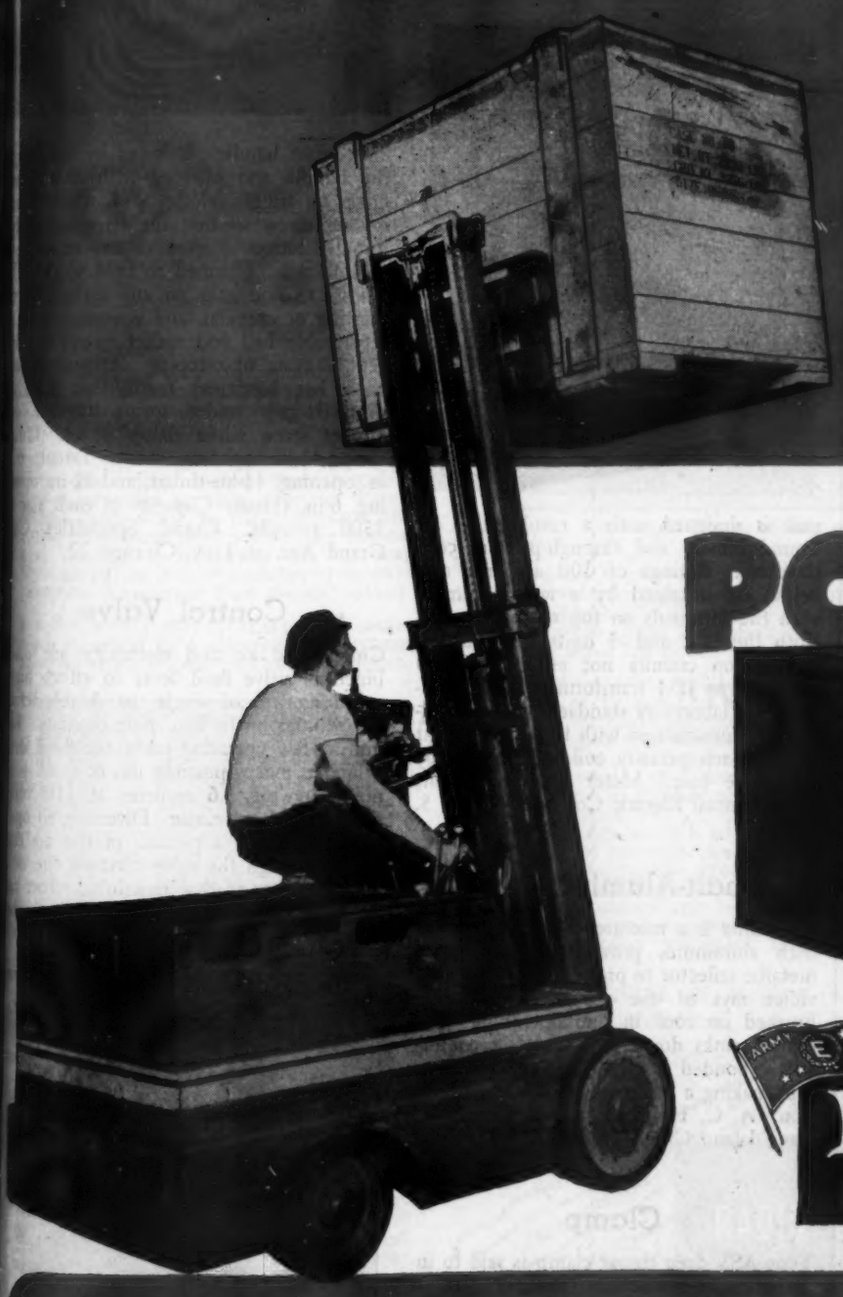

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● The performance and the service that you gain from your electric motors depends to a very great extent on the bearings you install. Quality should be your first thought when purchasing bearings—either for new equipment or for replacement.

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WHAT'S NEW IN EQUIPMENT

Portable Current Transformers

Types JP-2, -3, and -4 portable current transformers may be obtained as multi-range units. Model JP-2 is available also as a single-range unit. The JP-2 and -3 units meet the accuracy requirements of the ASA 0.3 accuracy class with burdens B-0.1, -0.2, and -0.5 at 60 cycles. Both units, of the through-window-type construction, are suitable for field testing or for laboratory-standard work. The JP-3

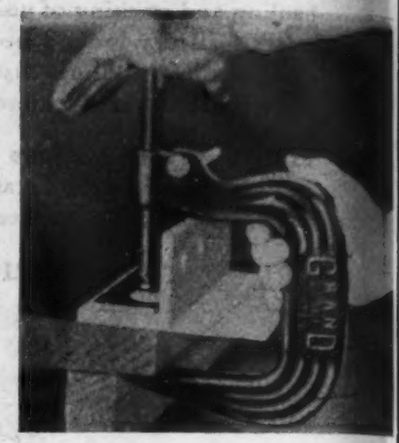
unit is designed with a combination of wound-primary and through-primary construction. Ratings of 100 amperes and below are obtained by a wound-primary with the terminals on top of transformer. Both the JP-2 and -3 units are insulated for use on circuits not exceeding 2500 volts. Type JP-4 transformer, for application as a laboratory standard, is of wound-primary construction with taps for different ratios. Each primary coil is protected by removable fuse. Meter and Instrument Div., General Electric Co., Schenectady 5.

Asphalt-Aluminum Paint

Hornlume is a mixture of asphalt coating with aluminum, providing asphalt with metallic reflector to protect it against ultra-violet rays of the sun. Compound is brushed on roof in one operation. The asphalt sinks down to bottom of coating and is bonded to roof; aluminum stays at top, making a protector-deflector combination. A. C. Horn Co., 43-36 Tenth St., Long Island City 1, N. Y.

Clamp

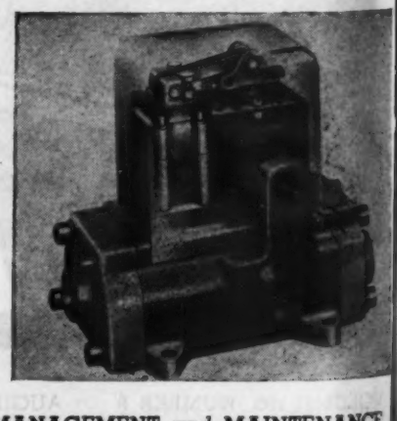
Type ASL deep throat clamp is said to incorporate quick-action features. It is positioned by pushing down on ratchet screw and tightening with a turn of the



loose-proof handle. Releases by loosening the handle and pushing with thumb or finger on trigger release pawl, which frees ratchet screw so that the clamp is ready for application to work of any other size or thickness. Claimed to hold work with a firm tension grip on any surface, even slanting or irregular, and is equipped with replaceable ball and socket swivel to prevent shifting or creeping. Trigger release pawl has hardened teeth that hold a meshed grip under spring tension on ratchet screw while clamp is set. Three sizes—4¾-in. opening, 4¼-in. throat; 6½-in. opening, 4¾-in. throat, and 8¾-in. opening, 6-in. throat. Capacity of each size is 3500 pounds. Grand Specialties Co., Grand Ave. at Troy, Chicago 22.

Control Valve

Compressed air and electricity are combined in valve fluid lever to effect high-speed control of single- or double-acting air cylinder up to ¾-in. pipe capacity. Requiring few operating parts, the fluid lever principle makes possible use of small solenoid, drawing 3.6 amperes at 110 volts, regardless of valve size. Diverting to operating advantage a portion of the air that passes through the valve controls the ratio of air balance so that remaining effort can be handled by small solenoid. Much mechanical burden is said to be eliminated,



How Rocket Powder is Heated 144 Times Faster With RCA Electron Tubes

Electronic Heat Cuts Heating Time from 24 Hours to 10 Minutes

R-f power passing between plates and through powder generates heat

The Problem: Rocket propellant charges are molded into the desired cross-section form (circle, cross, etc.) by forcing the material through correctly shaped dies. These extrusions are then cut to specified lengths. Before molding, the powder-mix must be accurately and uniformly heated *—without overheating or underheating any portions.*

Original Method: Mix was heated in an oven, usually while in cylindrical rolls about 10" in diameter. The time required to meet temperature specifications varied from 12 to 48 hours.

The Electronic Method: Rolls are placed between flat metal plates. High-frequency power, provided by RCA Electron Tubes, passes from plate to plate through the rolls, generating heat *within the powder* and heating it uniformly all the way through in less than 10 minutes—*144 times faster on the average than the old method.*

How It Works: Power for this process comes from standard RCA electronic generators, each of which is rated at 15,000 watts output. These units are simply electron-tube oscillators (similar to those in radio transmitters), which change 60-cycle commercial power into power at a frequency of approximately 10 million cycles per second. When this high-frequency power is passed through a dielectric (non-conducting material), such as the powder, it instantly generates heat uniformly throughout the material.

15-kw RCA Electronic Generator provides power for powder drying

Advantages of Electronic Heating of Non-Conductive Materials: Electronic heat can be controlled precisely. Heating is instantaneous when the power is applied, and stops instantly when the power is shut off.

General Advantages: Because there is no variation of temperature throughout the material, warping is minimized. Since heat is generated directly in the material to be heated, there is no warm-up time, and no heat is wasted as in the case of ovens, furnaces, steam-platens, and other heat-transfer devices.

With materials, such as thermosetting plastics, that set with the application of high temperature, the quick heating possible with electronic heating permits greater workability and results in fewer rejects. Production-line techniques can be employed, cutting processing time from days or hours to minutes—in some cases to seconds.

Turn to Electronics for Solution of Your Own Problems: If you are interested in electronic heating, write to RADIO CORPORATION OF AMERICA, Electronic Apparatus Section, Camden, N. J., Dept. T.

Electron tubes are providing a practical solution to hundreds of diversified manufacturing problems—process-control, machine-control, heat-treating of metals, plant-protection, and a host of others. Consult with RCA tube-application engineers for information or advice on possible applications of your own. For examples of some of the present-day uses of tubes send for the free booklet, "16 Examples of RCA Electron Tubes at Work in Industry." Write to RCA, Commercial Engineering Dept., Section 62-58L, Harrison, N. J.

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A Bostitch field specialist not only gave a definite answer to the problem quickly . . . one hand, one blow, with a Bostitch self-feeding hammer . . . but by borrowing from other customers was able to supply enough "oversold" equipment that same afternoon.

This . . . and thousands of other cases . . . illustrates how important are the smallest details . . . how this war in foreign lands reveals the vital importance of proper packing and shipping . . . how often the solution to a fastening problem is the application of some well-proved principle.

Bostitch field men . . . specializing exclusively in stapling . . . backed by forty years' engineering and manufacturing experience . . . will help you select . . . from nearly 800 models . . . the right Bostitch machine to fasten metal, plastics, wood, paper, cloth, rubber . . . in any combination.

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Bostitch (Boston Wire Stitcher Company) 75 Blackmore Street, East Greenwich, R.I. (or Bostitch-Canada, Ltd., Montreal).

Bostitch Staples in most sizes are now available.

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fastens it better, AND FASTER with wire

ALL TYPES OF STAPLES APPLIED BY MACHINES
ALL TYPES OF MACHINES FOR APPLYING STAPLES

and wear of parts reduced. Valve is suitable also for two-pressure control. The 4-way model can be converted for 3-way use by plugging one port. Straight line air flow minimizes pressure drop, simplifies installation, and requires few fittings. Numatics, Milford, Mich.

Smoke Detector

Photo-electric system detects presence of smoke in air conditioning ducts and immediately sounds alarms, turns off blowers, operates automatic dampers, or provides whatever other type of indication or control required, according to manufacturer. Consists of photo-electric control Type A26X and light source Type L11RX. Latter may be mounted to project beam of light over any distance from 10 to 25

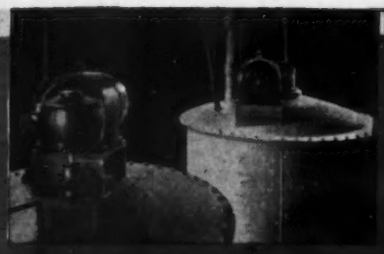
feet to eye of unit. Sensitivity adjustment on light source housing permits variation in intensity of light beam, and may be set for control to respond to smoke of predetermined density. Either current or tube failure will cause control to operate as though beam were interrupted. Both units are available either in Underwriter-approved explosion-proof housings, or weatherproof pressed steel. Photoswitch Inc., 77 Broadway, Cambridge 42, Mass.

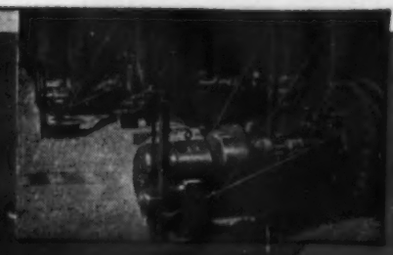
Safety Solvent

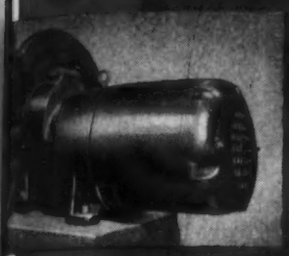
First of series of solvents, called G-SOL 195, is claimed to feature safety, noncorrosiveness, and solvency range. Compound is water white, characterized by flash point (ASTM) of 195 deg. F. min., fire point (ASTM)—200 deg. F. min. It is suitable for cleaning precision bearings, instrument parts, and similar mechanisms. Available in 5- and 54-gal. drums. Gaybex Corp., Nutley, N. J.

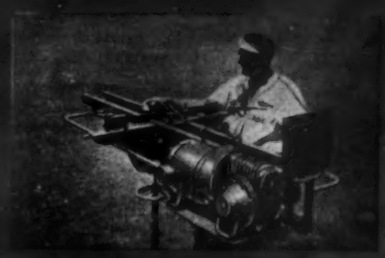
Automatic Operator

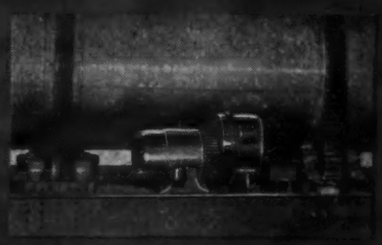
Converting hand machines into automatics by taking over all manual operations except renewing the feed, is the function of operating fixtures now on the market. Work is automatically located, clamped, brought to the cutter and removed after











make every one a SUCCESS STORY

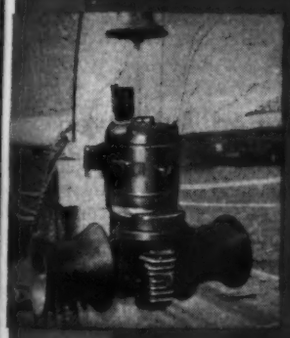
There is one *best* way to secure the slower speeds you need for most of your motor driven machinery . . . use Master Gearhead Motors.

With them you can lower your initial, installed cost. And you will find operating costs are low because of the gear units high efficiency (less than 2% power loss for each stage of parallel reduction).

They will add greatly to the compactness, appearance, convenience and safety of any of your machines.

But it's very important that you use MASTER gearhead motors, because nowhere else will you find units that are so flexible, so easily adaptable and in such a wide range of types and sizes. Any size, 100 horsepower and smaller . . . for all cycles, phase and frequencies . . . in open, splash proof, fan cooled and explosion proof types . . . with Speedrangers and Unibrakes . . . for every type of mounting . . . all of these are standard Master units, any of which can be easily combined into the one best integral power drive for each job.

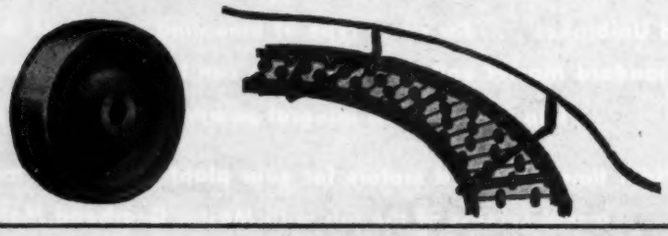
Next time you need motors for your plant or product, make a real success of the job with Master Gearhead Motors.



THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO

MATHEWS *Flexible* WHEEL CONVEYER

THESE sections of Wheel Conveyer with Universal Couplings and quickly adjustable Tripod Supports are ideal for handling cartons, cases, and miscellaneous light packages. The sections are available in 5′ and 10′ lengths, and with 8, 10 or 12 wheels per foot. The standard section width is 12″ overall. 45° and 90° Curves with adjustable guard are standard. The wheel used is a high-quality skate wheel, the result of 40 years of Mathews experience in conveyer bearing and wheel manufacture. Prices and complete information sent on request.

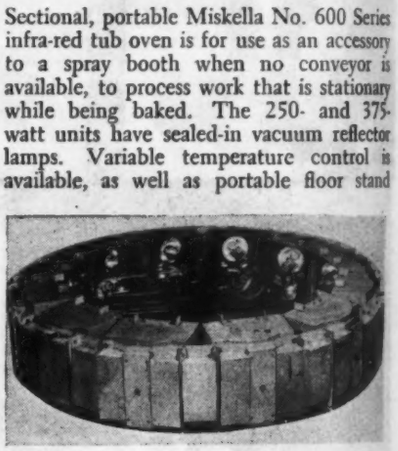


MATHEWS CONVEYER COMPANY
Ellwood City, Pa.
WEST COAST • MAILLER SEARLES, INC., SAN FRANCISCO
CANADA • MATHEWS CONVEYER CO., LTD., PORT HOPE, ONT.
ENGINEERING OFFICES OR SALES AGENCIES IN PRINCIPAL CITIES

machining, and cycle is repeated without further attention as long as feed lasts. Since workman's duties are reduced to renewing bar feed or refilling magazine or hopper, he can tend several machines. Fixture's automatic action is said to cut time required for hand control by more than one-half. Electric motor of ½ horsepower or less drives mechanical members that in turn actuate pneumatic parts. Assembly includes gear-driven, clutch-connected camshaft, acting through connecting and locating members to secure work in a vise that brings it to cutter. Units can be transferred to other machines, or detached. Pond Engineering Co., 15 Park St., Springfield, Mass.

Infra-Red Tub Oven

Sectional, portable Miskella No. 600 Series infra-red tub oven is for use as an accessory to a spray booth when no conveyor is available, to process work that is stationary while being baked. The 250- and 375-watt units have sealed-in vacuum reflector lamps. Variable temperature control is available, as well as portable floor stand



with utility shelf. Oven has flat sandwich-type top and floor, reflective metal interior and painted steel exterior, with insulation between, and vents for intake and outgo air. Each story is made up of ring of standard units, and each tub contains one or more stories—one story is 11 inches; two, 22; and three, 33 inches. Infra-Red Engineers & Designers, 1633 East 40 St., Cleveland 3.

Control Relay

For use in relaying output of electronic apparatus, instruments such as pyrometers, and for general control functions, Type WT relay for both a.c. and d.c. service is announced. Double pole design with

FOR

GREATER CAPACITY

IN THE SAME HOUSING BORE

BEARINGS: HYATT

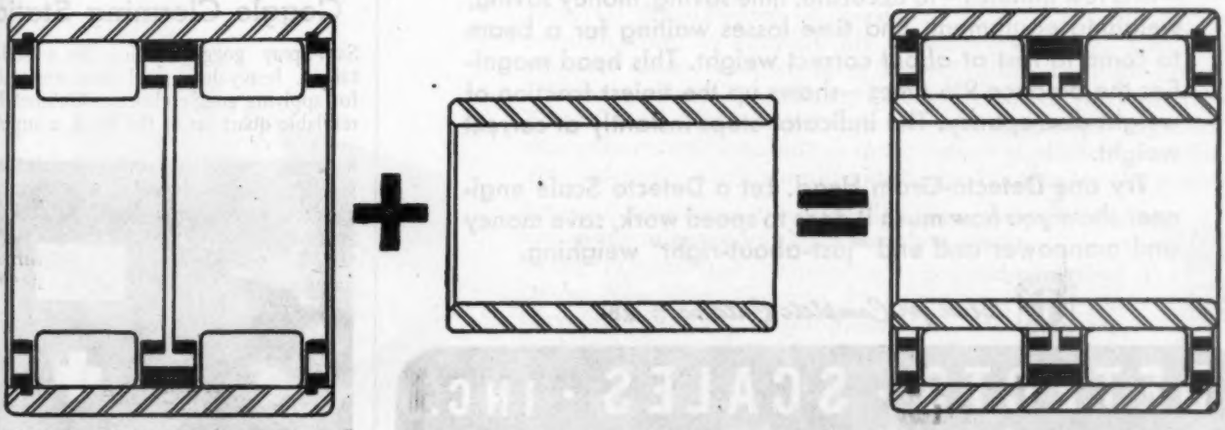
In the light series we provide a roller bearing of the same high precision as others in the Hy-Load range but in addition twice the load capacity of single row bearings of the same shaft diameter. It's the A-6200-TS "Duplex" type bearing with double roller assembly.

The component parts of this bearing are freely interchangeable. That is any inner race will fit any roller assembly of the same piece number—thus facilitating product assembly and disassembly.

This bearing like the other separable inner race bearings in the Hyatt Hy-Load line can be used with the inner race omitted and the rollers operated directly on a hardened and ground shaft.

Look into the Hyatt Hy-Load bearing application advantages—three types—separable inner and outer race—self-contained—and the double roller assembly.

Bulletin covering all types upon request.



HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION

Harrison, New Jersey · Chicago · Detroit · Pittsburgh · Oakland, California

DETECTO ENDS GUESSWORK IN WEIGHING

Converts ordinary scales into Precision Equipment

DETECTO-GRAM UNIVERSAL HEAD No. 1800

Eliminate overweight and underweight in your weighing operations. Convert one beam scale—or a battery of them—in a few minutes—to accurate, time saving, money saving, weighing equipment. End time losses waiting for a beam to come to rest at *about* correct weight. This head magnifies the balance 9½ times—shows up the tiniest fraction of weight discrepancy. The indicator stops instantly at correct weight.

Try one Detecto-Gram Head. Let a Detecto Scale engineer show you *how* much it does to speed work, save money and manpower and end "just-about-right" weighing.

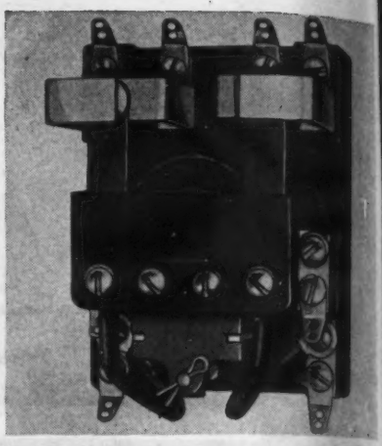
Send for Complete Catalog # 28

DETECTO · SCALES · INC.

MAKERS OF FINE SCALES SINCE 1900

ONE MAIN STREET · BROOKLYN 1, N. Y.

SCALE ENGINEERS IN ALL PRINCIPAL CITIES



poles electrically insulated on moving arm permits selection of circuits. A.c. relays are available with single pole auxiliary contacts of normally open, double-break design. Main contacts are rated at 10 amperes, 300 volts, and may be used on circuits up to 600 volts under certain conditions. Contacts are silver to silver, including auxiliary contacts on a.c. relays. Relay is mounted on thick molded base for direct mounting on metal bases. Front connected relays are standard. Optional rear-connected relays are furnished with stands extended through back of base. The Electric Controller & Mfg. Co., Cleveland 4.

Cement Dustproofer

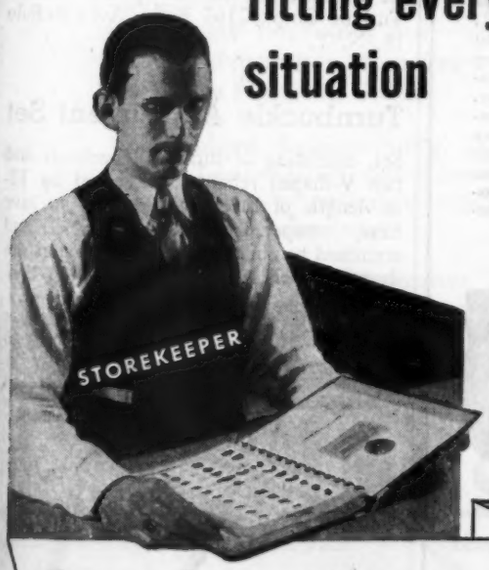
Known as Synkrete, liquid is a concentrate that is said to eliminate dusting at source. It is diluted with water, then applied by brush, mop, or sprinkler to saturate an area. Penetrates and reacts with the cement to harden into rocklike mass. Dries in few minutes, but reaction is not complete for several days. Floors become tough, resistant to traffic as well as effects of moisture and chemicals, and when painted two to three weeks after treatment, have less tendency to peel or blister than unpainted floors, maker claims. Synthex Products Co., 2 West 45th St., New York.

Goggle Cleaning Station

Sani-Spray goggle station is a self-contained, heavy-duty steel atomizer cabinet for applying goggle cleaner. Cabinet holds refillable quart jar of the fluid, a supply of

Welding Fittings Information

fitting every situation



IN PRACTICE, Tube Turns Catalog 111 has proved to be amazingly helpful to everybody concerned. *Consulting engineers* find it a veritable mine of conveniently organized information on the use and application of welding fittings. To the *design engineer* it furnishes both technical help and complete specifications.

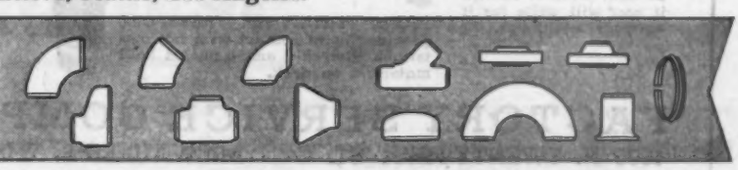
Catalog 111 reduces the *purchasing agent's* job to simplicity itself, with specifications conveniently thumb-indexed and printed in big, clear figures. For the *storekeeper,* it provides a complete pictorial arrangement of the entire Tube Turns line for instant identification, to simplify his inventory keeping. And in it the *pipefitter* discovers a world of helpful information for *his* job.

When you use Tube Turns Catalog 111, you have the complete line of over 4,000 items right at your fingertips, together with many charts and tabulations never before published. Let this valuable reference work simplify *your* job. It's free for the asking!

Selected Tube Turns distributors in every principal city are ready to serve you from complete stocks.

TUBE TURNS (Inc.), Louisville 1, Kentucky. *Branch Offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle, Los Angeles.

TUBE-TURN
TRADE MARK



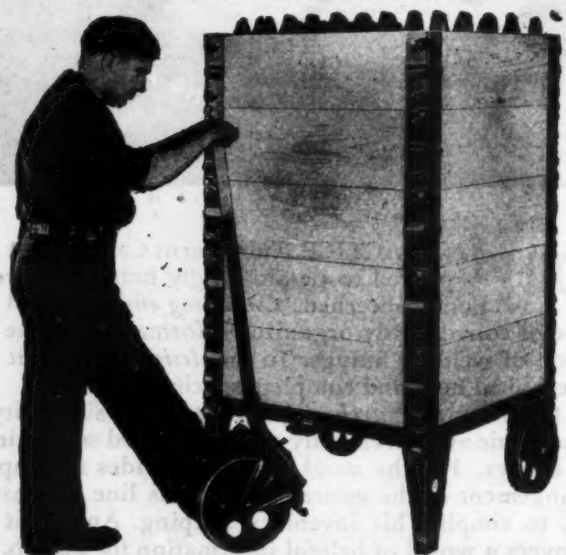
THE COMPLETE LINE OF WELDING FITTINGS AND FLANGES

The Judge Says:

60 DAYS FREE TRIAL

without Penalty or Obligation
if you've been GUILTY of NOT using the

TURNER SYSTEM
OF MATERIALS HANDLING



Bin Sections of wood or steel fit on the Turner Transport. Capacity is increased or reduced as needed. Loaded Transport easily moved with the Jimmy.

Frankly, it's no joke! Without the TURNER SYSTEM you have failed to utilize a method which has saved up to 50% in Labor Cost, Floor Space and Equipment Cost for hundreds of leading manufacturers.

We are so sure that you can benefit as well from the use of this system that we are willing to ship an assortment of standard units for 60 DAYS FREE TRIAL. Use them for at least two months. Keep them if (in your opinion) they save labor, time, and space. Return them if they don't. There is absolutely no obligation, except that you assume nominal transportation charges.

TURNER SYSTEM Described in Book

A copy of a 20 page book outlining the whole story of the TURNER SYSTEM will be sent without charge if you will write for it on your letterhead.

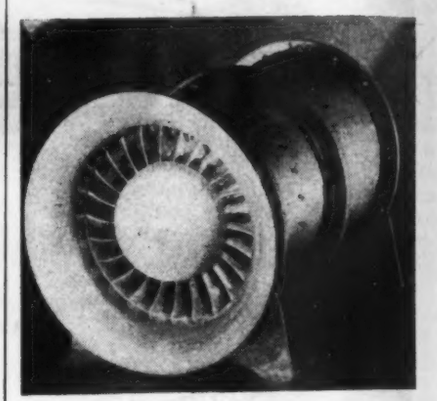
FLOOR PLATE DECK TRANSPORT provides point contact with hot materials. Non-skid embossments hold materials on deck.

FACTORY SERVICE COMPANY
4605 N. TWENTY-FIRST ST. MILWAUKEE 9, WISCONSIN

tissue paper, and built-in receptacle for used cleaning tissues. Pushbutton control releases fine mist of spray from an orifice on one side of the cabinet. Pressure is provided by connecting to the plant air line. Adjustable control valve regulates amount of spray applied. All apparatus is locked in cabinet. Refills are available in 1- and 5-gal. containers. Allen Optical Co., Buffalo 2, N. Y.

Compressors, Blowers, Fans

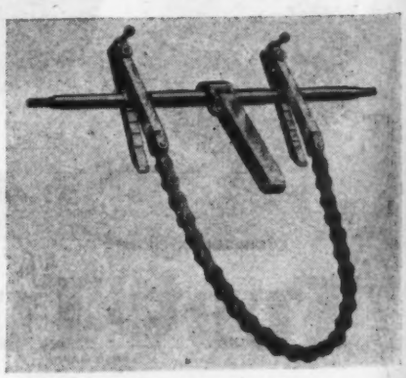
Line of axial-flow compressors, blowers, and fans, incorporates special motors having high horsepower and small diameters, because of high capacity and small size of units. Equipment has applications in heating, ventilating, and air conditioning fields requiring pressures up to 6 inches of water; dust removal, conveying, processing, drying, and forced draft blowers requiring 10



to 100 inches of water; and coke ovens, blast furnaces, and processing, requiring 3 to 100 p.s.i. Blower, 14 inches in diameter, delivers 8000 c.f.m. and 10-in. s.p., turning 3450 r.p.m., and is driven by 8-in. dia., 20-hp. motor. Pressure and efficiency characteristics are said to allow economical operation over a wide range. Noise level is low, as pressures and flows are obtained at reduced speeds. Buffalo Turbine Corp., 2165 Bailey Ave., Buffalo 11, N. Y.

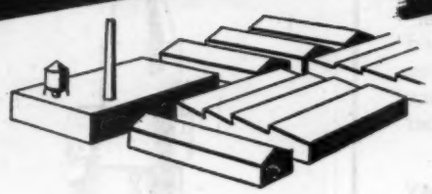
Turnbuckle Adjustment Set

Set, consisting of turnbuckle wrench and two V-shaped retainers connected by 12-in. length of link chain, is said to save time, temper, bruised knuckles, and scratched turnbuckles. When retainers are dropped over swedged cable fitting, con-



This Complete Pumping Unit

Is Built!



Is Guaranteed!

Is Serviced!

By FAIRBANKS-MORSE

Here's what that means to you. **In addition to sustained high efficiency pumping equipment—with its operation designed to do your particular job—you get three major advantages from Fairbanks-Morse Complete Pumping Units.**

1. **Combined Responsibility.** Designed and built in one factory, pump and driver (motor or engine) are perfectly matched and covered by a single guarantee.
2. **Successful UNIT Performance.** Tested in one plant under expert engineering supervision, pumps and drivers assure you superior operation.
3. **Service from ONE Source.** One engineer is familiar with the entire installation — no question as to who makes any adjustments or repairs.

You get these major advantages from Fairbanks-Morse . . . because only Fairbanks-Morse designs and builds all components of an outstanding line of complete pumping units.

To see a qualified engineer about any pumping job, write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

Fairbanks-Morse

A name worth remembering

Diesel Locomotives · Diesel Engines · Generators · Motors · Pumps · Scales
Magnetos · Stokers · Railroad Motor Cars and Standpipes · Farm Equipment

Air Filter QUIZ

1—IS IT ALL METAL?

All-metal filters are effective in preventing passage of fire in the ducts, and resist deterioration.

2—IS THE FILTER CLEANABLE?

Cleanable filters cost more to buy, but are much cheaper in the long run. They can pay for themselves in a year or two.

3—IS IT CONSTRUCTED TO RESIST VIBRATION?

The filter media should be of fixed density throughout. It must not shake down, leaving open spaces that will pass unfiltered air.

4—HAS IT AMPLE DIRT-HOLDING CAPACITY?

Filters that collect dirt on the surface only, need attention much oftener than filters providing a depth of dirt penetration. The latter hold more dirt, and still permit passage of air without undue restriction.

5—WHAT WILL BE THE INTERVAL BETWEEN SERVICING?

Man-hours are precious. Be sure you have enough filter area to provide the maximum operating period before filters need cleaning. To accomplish this, try to keep air velocity at face of filters around 300 feet per minute.

6—IS IT BEST SUITED TO MY PARTICULAR APPLICATION?

Every ventilating job is tailored to your need by your ventilating engineer. He knows that important factors such as size of particles to be collected, initial resistance, over-all efficiency, as well as cost, must be carefully considered for each application. Reliance on his judgment will save you money and assure permanent satisfaction with your air filters.

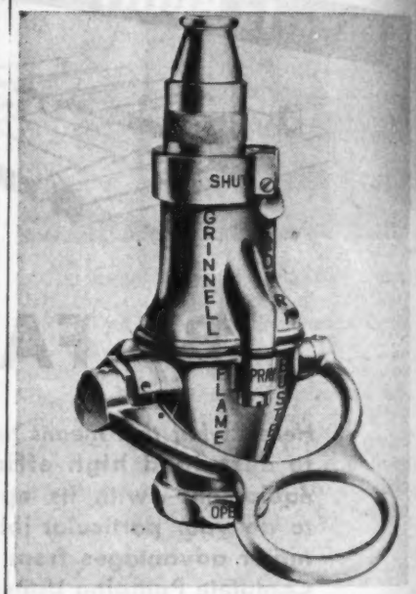
• • •

You get engineered filtration in every Air-Maze filter. Whether your interest in filters applies to air conditioning, ventilating, compressors, blowers or engines, remember—"If it uses air—use Air-Maze". Air-Maze Corporation, Cleveland 5, Ohio. Representatives in principal cities. In Canada: Williams & Wilson Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd., Vancouver.

verging steps in retainers adjust automatically on any fitting from ⅜- to 1¼-in. dia., weight of chain holding them in position; setscrew also is provided. Chain acts as rigid bar against the simultaneous clockwise and counterclockwise torque of swedged cable fitting set up when turnbuckle is turned, while its vertical flexibility permits clearance in tight spots. Wrench is self-adjusting; grip automatically tightens as wrench handle is pressed down; automatically releases and slides around turnbuckle to new grasping position when handle is raised. Aero Tool Co., Burbank, Calif.

Fire Hose Nozzle

When fighting fires in oils and other flammable liquids, Flamebuster is claimed to apply water for quick control, according to nature of the fire. Valve handle is adjustable for either spray or solid stream, and attaching proper tip to nozzle with bayonet-type catch ejects high or low velocity spray. For extinguishing fires in light, flammable liquids, low velocity spray

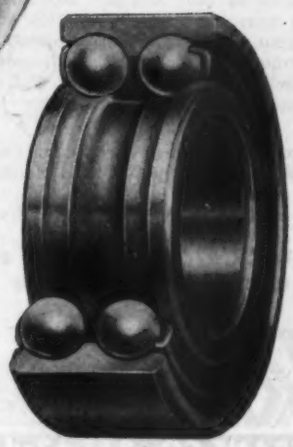


tip on 4- or 10-ft. applicator discharges wide angle cone of fine spray directly over blaze. Driving spray from high velocity tip emulsifies heavier blazing oil, rendering it incapable of burning, and affording fireman protection in approaching blaze, maker states. For mopping-up operations on wood or similar materials ignited by oil fires, and burning beyond range of spray, the solid stream is available. Large orifices in spray tips prevent clogging, and easy disassembly simplifies maintenance. Grinnell Co., Inc., Providence 1, R. I.

Rotary Pump

Steam-jacketed rotary pumping unit is designed for handling sludge and other viscous liquids. It has capacity of 500 g.p.m. at 150 p.s.i. pressure, and is powered by 75-hp. gearhead motor with speed of 155 r.p.m. on drive shaft. Construction is iron, bronze-fitted, and unit is mounted on cast-iron base. Steam jackets

TURNING OUT HEART BEATS FOR BULLDOZERS



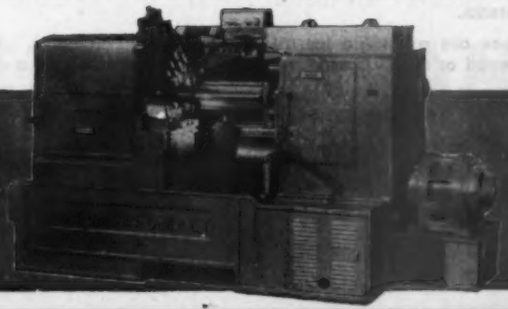
Fafnir inner rings for this #5206W bearing are machined to exacting tolerances at the large Fafnir plants in New Britain, Connecticut

Few weapons of this war have won greater admiration than the versatile and powerful bulldozers. These modern giants are clearing jungles, building airstrips and destroying Jap pillboxes . . . making ready for new advances against the enemy. Behind this big push is a story of Fafnir Ball Bearing performance . . . guaranteeing smooth and dependable action of the gear pump mechanism which hydraulically operates the dozers. Failure of the gear pumps to respond would "kill this workhorse".

The model 61 pictured above is but one of the many New Britains turning out the inner rings of these Fafnirs for gear pumps since early 1940 . . . twenty-four hours a day, seven days a week with downtime held to a minimum. One cycle of the New Britain turns the outside diameter and the bore, forms both ball races, forms the recess between races and finishes both faces . . . speedily and accurately.

You too can profit from this same unprecedented performance in the competitive era just ahead . . . a period when price-per-piece will be an important factor in successful selling. It is to your advantage to discuss your production problems and requirements with the New Britain Sales-Engineer in your district. He has the automatic solution.

NEW BRITAIN AUTOMATICS



THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN, CONNECTICUT
NEW BRITAIN-GRIDLEY MACHINE DIVISION

Official U. S. Navy Photo

KRANE KAR has *original* features that facilitate crane operation: from one set of controls near the wheel, driver operates crane travel, (forward and reverse), boom swing (180°), and load hoisting. Front wheel drive makes steering easy; vision is unobstructed; boom and load braking is automatic; no stabilizers needed. This safe, easy operation speeds handling of steel, machinery, fixtures; heavy, bulky loads of any type whatever. Faster handling saves time and labor . . . brings costs *down* where they belong! Write for Catalog #58.

USERS: Hercules Powder, Boeing Airplane, Certainteed Products, Standard Oil, Monsanto Chemical, Ford Machinery, Wagner Electric, General Motors, National Lead, Koppers, etc.

Agents in the Principal Cities

THE ORIGINAL SWING BOOM MOBILE CRANE WITH FRONT-WHEEL DRIVE AND REAR-WHEEL STEER

2½, 5, AND 10 TON CAPACITIES

KRANE KAR

SILENT HOIST & CRANE CO., 855 63rd ST., B'KLYN 20, N.Y.

GRANT

Ball Bearing DRAWER SLIDES

Supreme Type "S" Slide . . . for installation on drawers and cases where smooth, fingertip operation is of utmost importance.

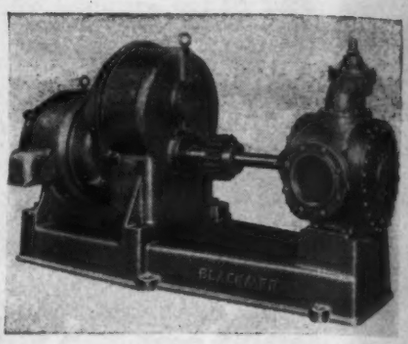
Make your cabinets smoother, easier to use and safer . . . by quick, easy installation of the "Grant".

Grant Ball Bearing Drawer Slides . . . save time in shop, toolroom or office, by assuring greater speed and convenience in drawer operation. Costly tools, gages, etc. are better protected by the smooth, safe drawer action and by the fact that there is never any possibility of drawers being pulled out too far and spilling the contents.

Types are available for all purposes and capacities. Attachment can be made to wood or steel cabinets by anyone who can handle a drill and screwdriver.

Made of rust-resisting plated steel in any desired length. Investigate today by sending for illustrated literature.

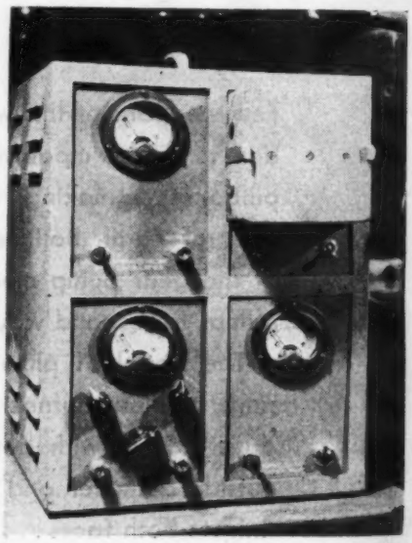
GRANT PULLEY and HARDWARE CO.
33-42 57th Street, WOODSIDE, Long Island, New York



are suitable for pressures up to 125 p.s.i. and are located on both heads. Units in capacities of 50, 90, and 200 g.p.m., with gearhead motor or reduction gear drive also are available with steam-jacketed heads. Units operate on the bucket design, swinging vane principle, and are self-adjusting for wear. The Blackmer Pump Co., Grand Rapids 9, Mich.

Current Force Recorder

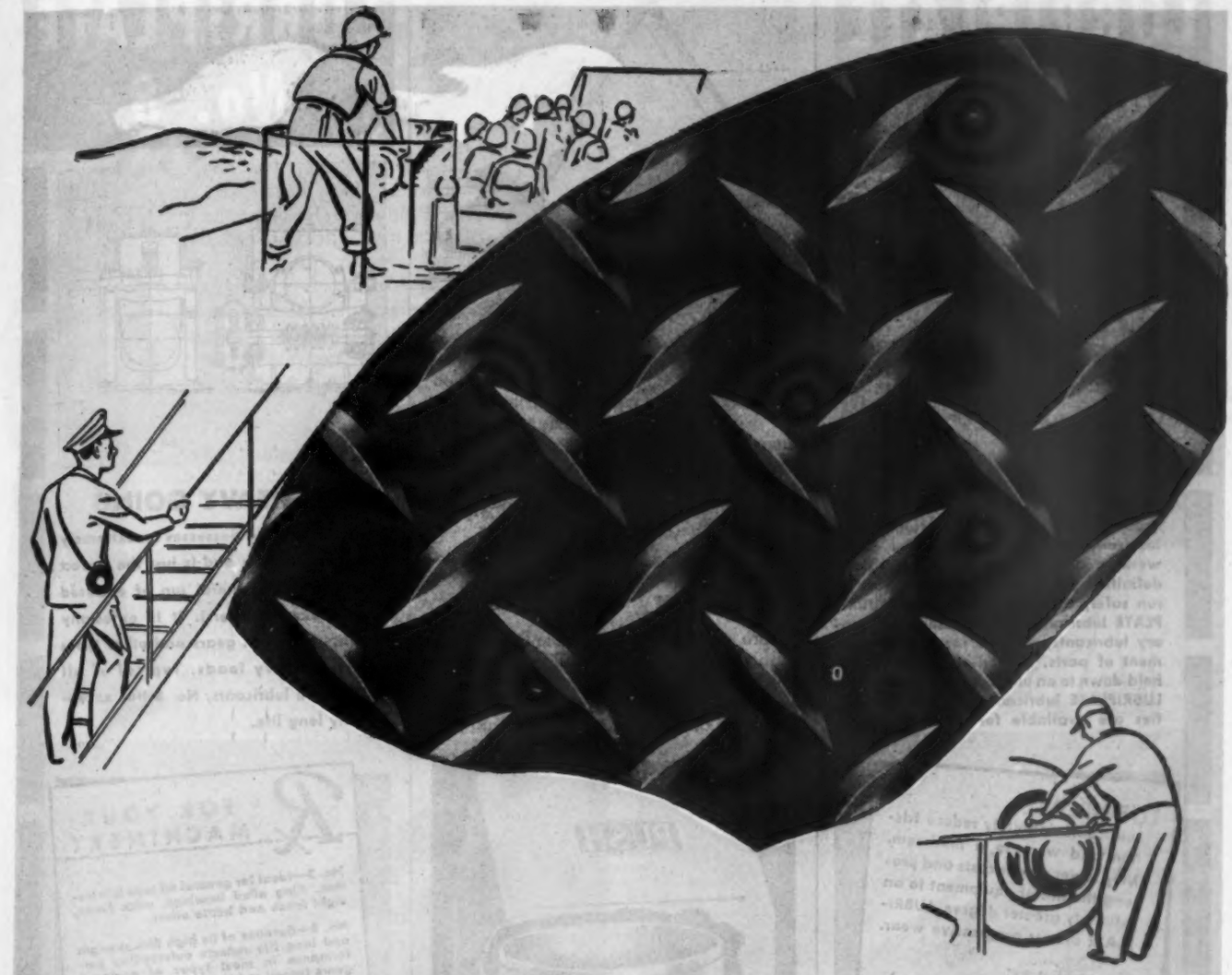
Portable unit for recording current and force in resistance welding machine electrodes is announced. For use in welding research and for the periodical checking of welding machine performance, recorder is designed to be helpful to users of energy-storage type welding machines for determining when forge pressure is applied to the work with respect to the discharge of



welding current. Recorder consists of electrode holder and amplifier-oscillograph unit which operates from 115-volt, single-phase, 60-cycle power source, and is composed of single-channel amplifier, oscillator, power unit, and small magnetic oscillograph. Special Products Div., General Electric Co., Schenectady 5, N. Y.

Fluorescent Lamp Magnifier

Adaptation of magnifying lens to fluorescent lighting is announced. Super Sight lens and light assembly are mounted on balanced bracket that can be placed in any position over work area. Applicable where magnifier is used continuously in



A sailor on a landing barge . . .

A watchman on a fire escape . . .

An engineer in a power plant . . .

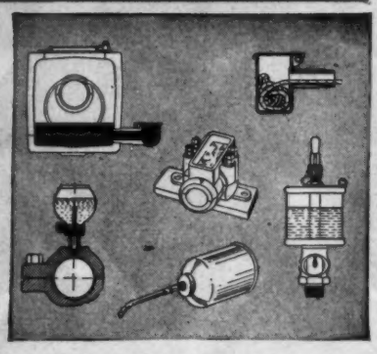
A stevedore on a loading platform . . .

Every time he puts his foot *down*, forty Diamond Treads are there — reaching *up* to give him extra traction; to hold him against slipping in any direction. That is what "A.W." Super-Diamond Floor Plate means to workers in industrial plants, refineries, railroads, on ship-board. Easy to clean. Quick to drain. Toughest use will not damage it. Can be installed overnight without disturbing production. Write for catalog.

ALAN WOOD STEEL COMPANY

SINCE 1826 :: CONSHOHOCKEN, PENNSYLVANIA :: District Offices and Representatives:
Philadelphia New York Boston Atlanta Buffalo Chicago Cincinnati Cleveland
Denver Detroit Houston St. Paul New Orleans Pittsburgh
Roanoke Los Angeles San Francisco Seattle Montreal

LUBRIPLATE Nos. 1-2-3-4



FOR HIGHER SPEEDS

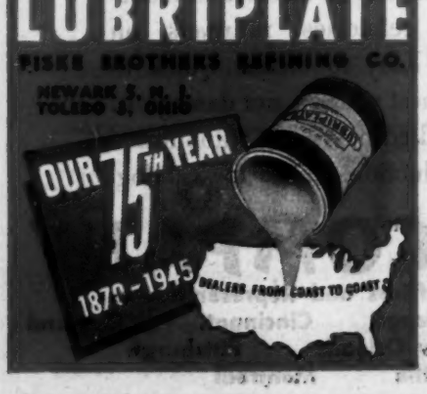
Probably the severest tests for high speed lubricants occur in the textile and woodworking industries. These industries have definitely proven that machines can be run safely at higher speeds with LUBRIPLATE lubricants. With these revolutionary lubricants, there is far less replacement of parts. Burned-out bearings are held down to an unprecedented minimum. LUBRIPLATE lubricants in various densities are available for all applications.

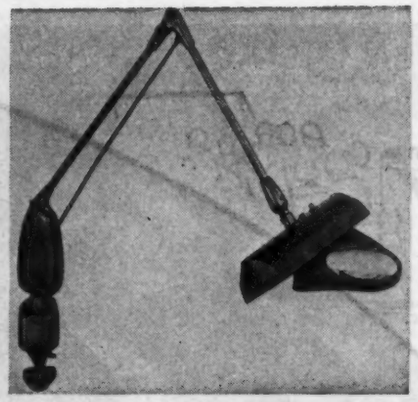
LUBRIPLATE
Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

LUBRIPLATE
Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

LUBRIPLATE
Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

Write for a booklet, "The LUBRIPLATE Film", written especially for your industry.

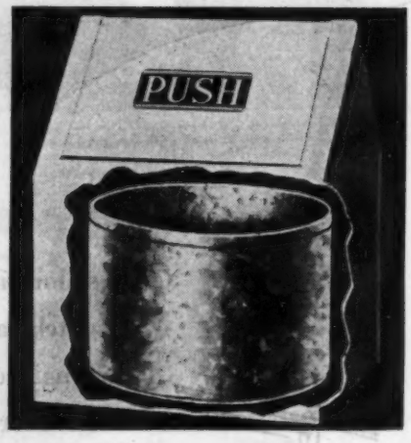




engineering, shop work, and inspection. Supplied in three types of lighting—standard bayonet type bulbs, lamps sealed to relieve explosion hazard, and fluorescent lamps. Three types of brackets and two sizes of lenses can be supplied. The Boyer-Campbell Co., Safety Div., 6540 St. Antoine St., Detroit 2.

Sanitary Receptacle

Mypro steel sanitary receptacle for women's washrooms is designed for placement under toilet partitions. Receptacle weighs 5¼ pounds, and is 9x9x11½ inches in over-all size, with outer cover of 24-gage hot-rolled

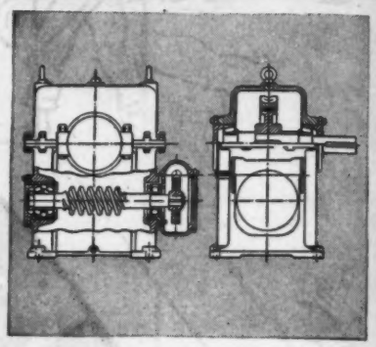


steel, turned edges, spot-welded, and finished in white or green enamel. Swing top flips open and inner container of seam-welded galvanized steel is removable. Philip Shore & Associates, 837 Traction Ave., Los Angeles 13.

Truck Battery Chargers

Two battery chargers have been designed to enable the industrial truck operator to charge batteries. Single-circuit charger charges one battery at a time; the four-circuit charger can charge one to four batteries simultaneously. Easy to operate—pushing in connecting plug charges lead-acid batteries. When charging Edison batteries, a time clock is set. The charging current begins at the proper value automatically, and charging current is controlled throughout at rates established by the electric truck and battery industry. Equipment shuts down in case of power failure; when power is restored, charging

LUBRIPLATE No. 8



FOR HEAVY GOING

LUBRIPLATE No. 8 possesses an extremely high film strength and is just the correct density for the general run of enclosed gears (speed reducers). It is especially suitable for worm gears and other types carrying heavy loads. Typical of all LUBRIPLATE lubricants, No. 8 has exceptionally long life.

℞ FOR YOUR MACHINERY

No. 3—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers).

No. 107—One of the most popular grease type products for general application by pressure gun or cups.

No. 70—For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

Write for a booklet, "The LUBRIPLATE Film", written especially for your industry.

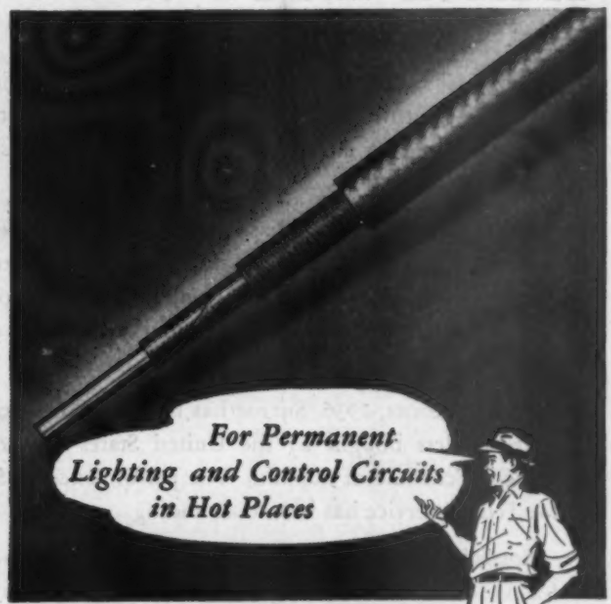
Time to rewire the Hot Spots

Now that you can *select* whatever you want in wire and cable it's time to take a trouble-shooting trip around your plant . . . check up on war-weakened power, lighting and control circuits that run around boilers, furnaces, steam lines, soaking pits, kilns, lehrs or other hot spots . . . and don't forget the motor leads that have taken more than their share of over-load-heat, oil or grease. Then plan to replace all emergency war-time wiring that won't take years of abuse in locations where *trouble* starts—with *permanently insulated* Rockbestos A.V.C.

Every wire, cable and cord in the Rockbestos line was designed to stand up in an installation where other wires failed. They are all highly resistant to heat, moisture, oil, grease, corrosive fumes and flame. And they eliminate wire-failures and prevent service interruptions.

ROCKBESTOS A.V.C. 600 V. MOTOR LEAD CABLE
(Nat. Elec. Code, Type AVA—max. operating temp. 110°C.)
Flexible conductor insulated with two impregnated felted asbestos walls and a high dielectric varnished cambric insert and covered with an asbestos braid. Resistant to heat, flame, moisture, oil and grease. Sizes No. 18 AWG to 1,000,000 CM.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA—max. operating temp. 110°C.)
Insulated with two impregnated felted asbestos walls and a high dielectric varnished cambric insert and covered with a rugged asbestos braid—withstands heat and condensation in steam tunnels, boiler rooms, etc. In sizes No. 18 AWG to 2,000,000 CM.



ROCKBESTOS A.V.C. 600 V. BOILER ROOM WIRE
(Nat. Elec. Code Type AVA—max. operating temp. 110°C.)
Insulated with high dielectric varnished cambric, impregnated felted asbestos and covered with an asbestos braid. Heat, flame and moisture resistant for permanent control and lighting circuits in hot locations. In sizes No. 18 to 4/0 AWG.

Send for samples of these *permanently insulated* Rockbestos wires and a catalog describing many of our 125 standard constructions and Rockbestos-designed National Electrical Code types. Write to your nearest district office or:
ROCKBESTOS PRODUCTS CORPORATION
600 Nicoll St., New Haven 4, Conn.

ROCKBESTOS A.V.C.

THE WIRE
WITH PERMANENT INSULATION

FOR VICTORY . . . BUY MORE WAR BONDS

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

MINE HOST to the Village

In Colonial times, the village pump was a focal point of community life. Here the townsfolk paused for the refreshment of a cool drink of water, lingered to chat with neighbors, extended simple hospitality to the wayfarer.

Today, wherever people assemble, or are employed, the same need for a source of cool drinking-water is apparent. Sturdy, dependable Sunroc Water Coolers are designed to fill this growing need . . . as they did for civilian America prior to Pearl Harbor, and in the service of the armed forces, during the war.

Since October, 1936, Sunroc has been sole contractor for all electric water coolers bought by the United States Government, from the General Schedule of Supplies. The performance of Sunroc Coolers in the Federal service has been outstanding.

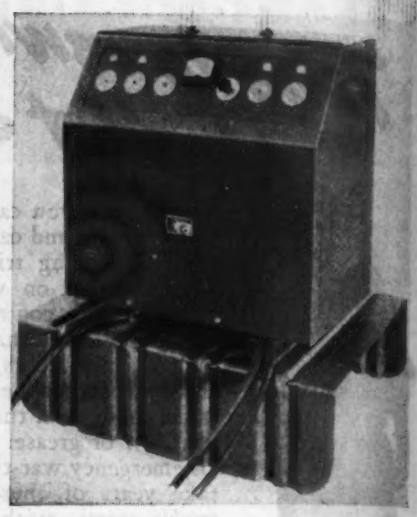
Specialization in its sole product . . . water coolers . . . is responsible for present Sunroc leadership. Sunroc Water Coolers are now available for essential use. Write Dep't FM-8 for full particulars. Sunroc Refrigeration Company, Glen Riddle, Pa.

"There's nothing like a *cool drink of water!"*

SUNROC

Water Coolers

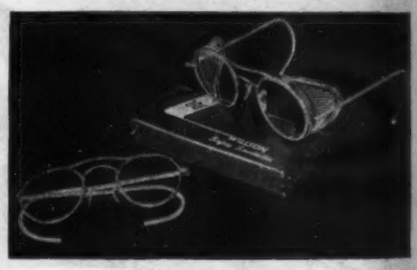
GLEN RIDDLE, PA.



resumes, and charger shuts down when battery is charged fully. No manual attention is required during charge. The Electric Products Co., Clarkstone Road, Cleveland 12.

Protective Glasses

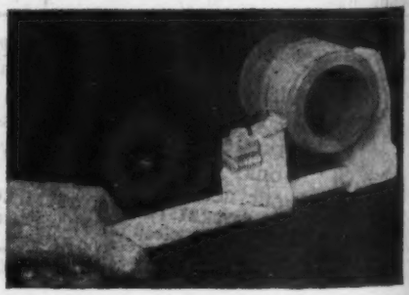
Spectacles provide eye protection because lenses are heat-treated, every lens is individually tested for impact strength and optical clarity, and frames are reinforced, according to manufacturer. Frames look like ordinary prescription spectacle frames, and lenses may be ground to prescription



if desired. Twenty frame sizes with self-adjusting plastic rocker nose pads and adjustable cable temples are available. Can be obtained with or without one of 10 types of side shields in clear or green plastic, wire mesh, or leather. Have clear flat lenses, 1.25 curve or 6 curve, or flat green glass in four shades. Wilson Products, Inc., Reading, Pa.

Thread Repair

No. 897 outside thread chaser simplifies job of restoring battered threads on axle housings, cages, and other parts. Handles



Gilmer V-BELTS

They stand the heavy strain of 'round-the-clock service

Every structural detail of a Gilmer V-Belt is designed for long, hard service. Special compounds, developed by Gilmer research, thoroughly bond the strong pulling cords, keep them separated and riding in parallel, thus eliminating internal friction. And the heavy protecting jacket is extra tough and wear-resisting.

Gilmer V-Belts are precision moulded with so high a degree of exactness that they are "matched" to the same lengths within very small tolerances. They operate on any drive, under correct tension, without need for rematching. This feature, combined with a tight-holding grip, assures a steady, powerful pull . . . in low or high speed service . . . on long or short center drives.

Gilmer has the largest assortment of V-Moulds in the world . . . FHP and multiple, endless and non-endless. Whatever your requirements, there is a Gilmer V-Belt to meet them.

Write for a FREE copy of the Gilmer Guide, the most complete V-Belt catalog in the field. It contains valuable engineering information, standard sheave and belt tables, and other useful data.

Gilmer makes a complete line of belts and belting for every power transmission need.

L. H. GILMER COMPANY
Tacony, Philadelphia 35, Pa.
Division of United States Rubber Company

Gilmer BELTS

ALL THREE CHOOSE G-E

Users of fluorescent lighting, engineers and maintenance men are improving their lighting service by switching to G-E Watch Dog Fluorescent Starters. These manual reset starters are providing efficient service and positive protection for 30-, 40- and 100-watt lamps in commercial and industrial installations all over the nation. Here are only a few of the many reasons why all three choose G-E.

You can get the complete story about G-E Watch Dog Starters by writing to Section G854-37, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

1.

Users are protected from annoying blink and flicker of dying fluorescent lamps once and for all. Blinking cannot possibly recur once the Watch Dog cuts out.

2.

Lighting Engineers specify G-E Watch Dog Starters because of their unusually long life. Under specified test conditions the FS-40 outlasts ten 40-watt fluorescent lamps.

3.

Maintenance Men prefer G-E because the Watch Dogs are loyal friends. They reduce lighting maintenance to the easy job of pushing a red button before relamping. Simply reset it . . . forget it.

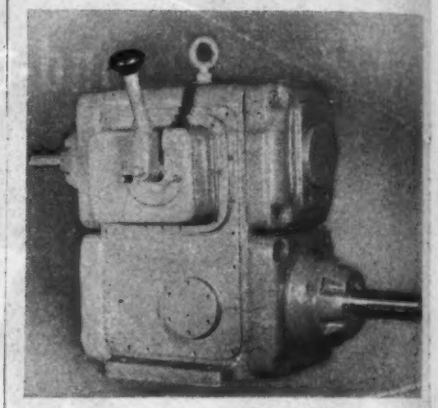
BUY WAR BONDS AND KEEP THEM

GENERAL ELECTRIC

from 1- to 5-in. diameter, and is adjustable to needed size. Operation includes applying on good threads, tightening slightly, and then backing tool off over damaged threads, increasing pressure slightly on each succeeding cut. Owatonna Tool Co., 363 Cedar St., Owatonna, Minn.

Hydraulic Transmission

Featuring continuous duty performance under varying conditions of load and speed, Model HT-1 hydraulic variable speed transmission is announced for heavy-duty industrial applications. Speeds are from zero or full neutral position to maximum motor speeds both forward and reverse, with torque output remaining constant. Horsepowers available are 5, 7½, 10, 15, and 20. Maximum speed, depending



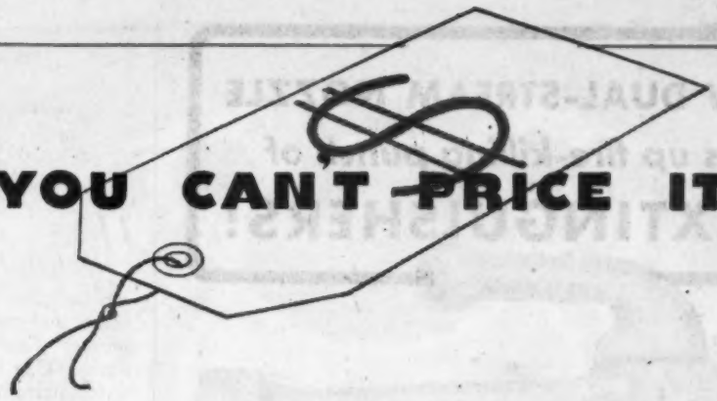
on speed of electric drive motors or other prime movers, is rated from 900 to 1700 r.p.m. Flexibility of control under all operating conditions is claimed. Control mechanisms, in addition to hand lever, are available, including remote control stations. Transmission can be furnished with electric drive motors for different electric current specifications, and to include base for mounting equipment. Portman Machine Tool Co., 70 Portman Rd., New Rochelle, N. Y.

Company Changes Name

Spencer Lens Company, Buffalo 11, N. Y., is now known as the Scientific Instrument Division of American Optical Company, manufacturers of ophthalmic products.

Thermal Relay

Winding-temperature relay permits utilization of maximum permissible emergency-overload capacity of power transformers under all ambient temperature conditions maker states. Equipment operates from combination of top oil temperature, ambient temperature, and load current, enabling winding hot-spot temperatures to be limited to values recommended by industry standards. Relay has three separate contacts that close in sequence as winding temperature increases. On transformer with cooling fans for supplementary rating, the relay can start cooling fans as soon as capacity of transformer is exceeded; give warning signal when overload



YOU CAN'T PRICE IT!

YOU CAN'T STOCK IT!

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... but it's all we have to sell

Service . . . it's a word difficult to picture or express but it's all we have to sell. To us at Levinson Steel it means a pleasant "hello" when you're 'phoning for steel . . . the knack of letting you know we would like to be helpful . . . the faculty of handling your problems in a conscientious manner. Or it may mean hiring a truck at 11:00 p.m., calling the Coast about an urgent shipment at 3:00 a.m., or getting a mill-wright out of bed at 5:00 a.m. It means going to any length at any time to do your job the way you want it done . . . all of this the pleasant, personal, amiable Levinson way!

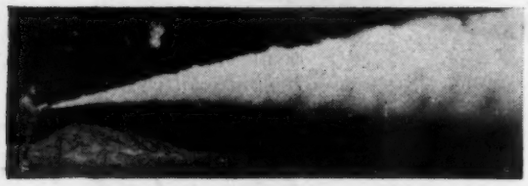
LEVINSON STEEL

LEVINSON STEEL SALES CO. LSS-2

33 PRIDE STREET • PITTSBURGH, 19, PA.

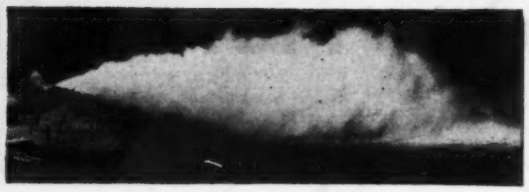
NOW...NEW DUAL-STREAM NOZZLE
further steps up fire-killing punch of
DUGAS EXTINGUISHERS!

NEW DUAL-STREAM NOZZLE deals effectively with spill fires and fires difficult to reach because of height or obstructions. Designed for use with DUGAS wheeled extinguishers, the new Dual-Stream Nozzle greatly increases fire fighting range and effectiveness. A turn of the handle gives a *straight* stream with a range of 45 feet—or a *fan* stream with a range of 15 feet.



STRAIGHT STREAM of fire-killing DUGAS Dry Chemical permits a large fire to be knocked down from a safe distance before operator goes in to extinguish it.

FAN STREAM enables operator to concentrate heavy cloud of DUGAS Dry Chemical on fire and minimizes flash-backs.



***Quick Facts about* DUGAS Dry Chemical**

- For extra-hazardous fires involving flammable gases, liquids, greases or electrical equipment.
- Not an electrical conductor.
- Non-toxic, non-corrosive, non-abrasive.
- Not affected by extreme cold or heat.

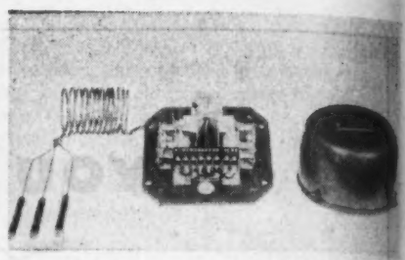
Write today for complete information regarding DUGAS Wheeled Extinguishers with the New Dual-Stream Nozzle . . . and DUGAS Hand Extinguishers.

AN ANSUL PRODUCT
duGas
THE MASTER OF FLAME

Approved by Underwriters' Laboratories, Factory Mutual Laboratories.

DUGAS 150-A WHEELED EXTINGUISHER

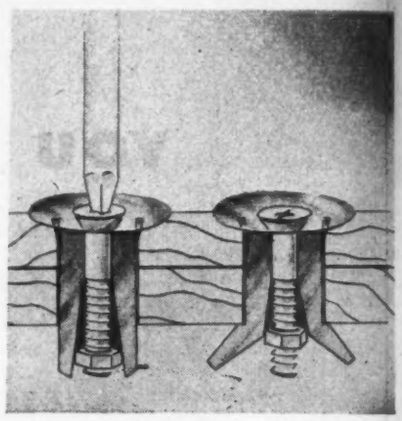
ANSUL CHEMICAL COMPANY, MARINETTE, WISCONSIN
DUGAS DIVISION



has been on for the permissible length of time; and sound alarm or trip circuit breaker when overload exceeds specified limits. Can be checked in the field without interrupting load on transformer. Transformer Div., General Electric Co., Schenectady 5.

Blind Bolt Assembly

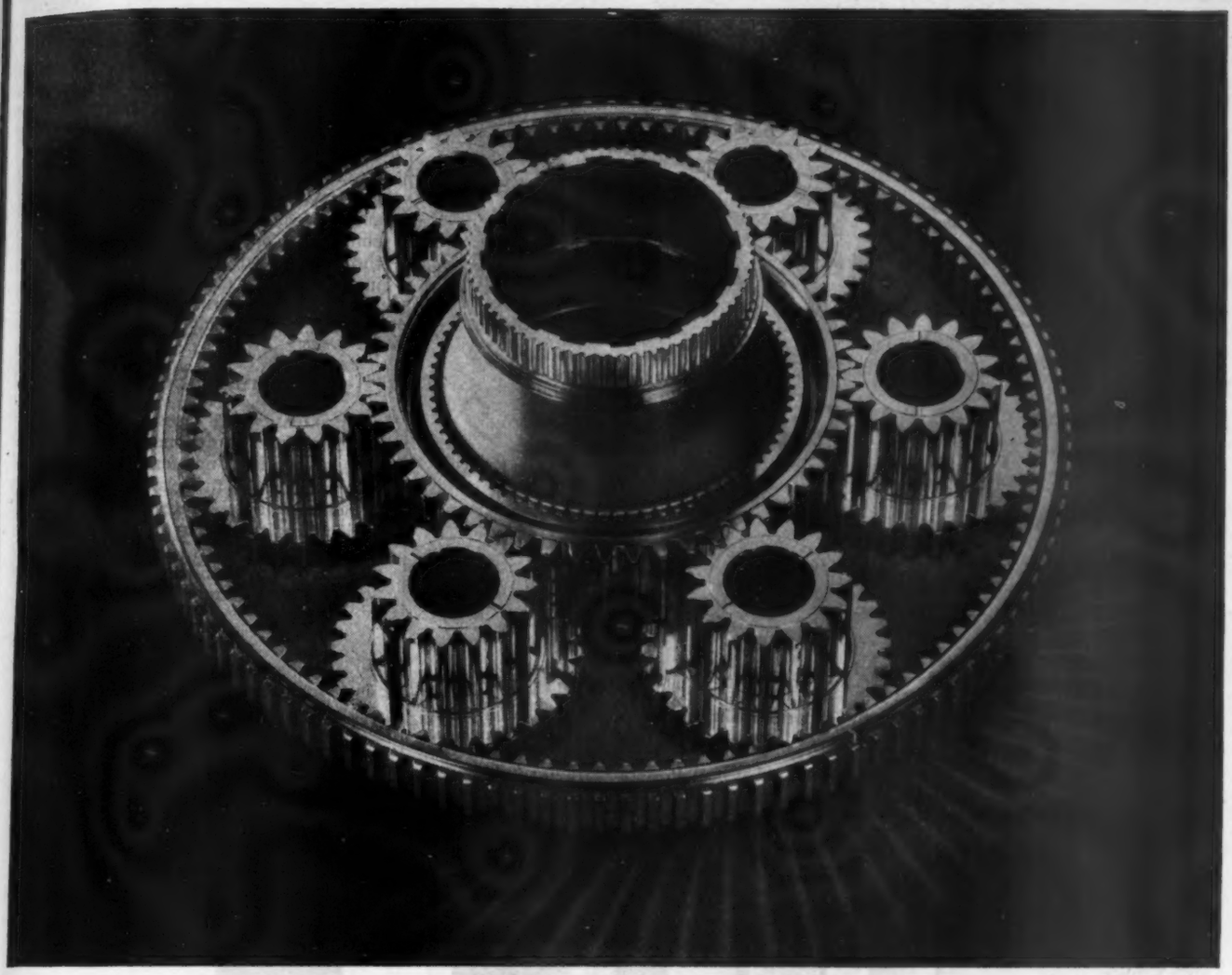
Des-Bolt, a plastic fastening device, is composed of molded plastic expansion sleeve and standard nut and bolt assembly of size to match sleeve. The sleeve is made of three thin fingers with inside taper. Head is a flange with cored hole to accommodate bolt shank, and countersunk to receive standard countersink type of bolts, with three sharp ribs attaching the flange and sleeve. Ribs wedge into the work and



prevent sleeve from turning. Assembled unit is inserted into drilled hole, tapped lightly with screwdriver, and bolt is tightened. Nut is restrained from turning by inside tapered surface of prongs of sleeve. When used in fabrication of laminated sections for such applications as partitions and walls, the assembly is said to prevent marring of the surface, to be suitable where hardness of the material being fastened would prevent use of nails or screws, and can be applied by one man from one side of the partition. Engineering Dept. 2E, Victory Mfg. Co., 1105 So. Fairoaks Ave., So. Pasadena, Calif.

Hoist Drive

Maxspeed hoist drive for cranes automatically measures the load so that it is hoisted and lowered at maximum safe speed, preventing handling dangerous overloads. Designed for use on either indoor overhead, slow-speed cranes, or high-speed cranes for outdoor construction. Operates from either a.c. or d.c. incoming power. If used with a.c., drive consists of gen-



Here's the heart of a mighty engine

You are looking at the transmission of a giant aircraft engine. Delicate as these gears seem, they possess the tough strength and endurance to carry a mighty bomber on its thousand mile mission—and back—time after time. This dramatic coupling of rugged strength and light weight—of mighty power and compactness is made possible by new gear production methods developed by Foote Bros.

The big miracles these revolutionary type gears perform are due to the extremely close tolerances to which every dimension is held—to the unique developments in heat-treating that assure the proper hardness of every part—to the extraordinary control of every step in production that permits their manufacture in quantities even though specifications demand laboratory precision.

These new A-Q (Aircraft Quality) gears are already suggesting revolutionary changes in many peacetime machines. They are permitting smaller, more compact design—they are making possible greatly increased operating speeds—they are assuring longer life to machines and equipment on which they are used.

Designers and production engineers interested in the possibilities of these new gears will find complete data on them in a bulletin recently issued by Foote Bros. Write for a copy of Bulletin A-Q-A. It will be sent to you upon request.

* * *

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. I, 5225 S. Western Boulevard • Chicago 9, Ill.

This engineering bulletin on A-Q gears gives complete engineering data, comparative performance curves, design details and other information on this revolutionary type gearing.

FOOTE BROS.

Better Power Transmission Through Better Gears

You can't afford to be "hooked" by materials-handling problems, by out-moded methods of moving, piling and stacking that lose you time and money—affect the efficiency of your whole business structure!

There is a SIMPLE, SPEEDY way—with Rapid-Wheel Portable Gravity Conveyor. Light and strong, easy to set up and operate, Rapid-Wheel Conveyors are well-adapted to use wherever there is a handling job to be performed. They eliminate the need for slow, costly hand labor and are soundly constructed from the best of materials to give you years of economical, dependable service.

The new, handy Cam-lock standards provide a full range of adjustments up to 50" operating height; fold completely under conveyor frame when not in use. Self-adjusting, easily locked, these standards make each Rapid-Wheel Conveyor section a compact, self-contained unit.

Investigate this labor-saver thoroughly; write for full particulars TODAY. Hundreds of users are finding the Rapid-Wheel Portable Conveyor the answer to handling problems — proving to be the best investment they ever made.

OFFICES IN PRINCIPAL CITIES

Manufacturers of
STEEL FORGED CASTERS - TRUCKS - CONVEYORS - POWER BOOSTERS

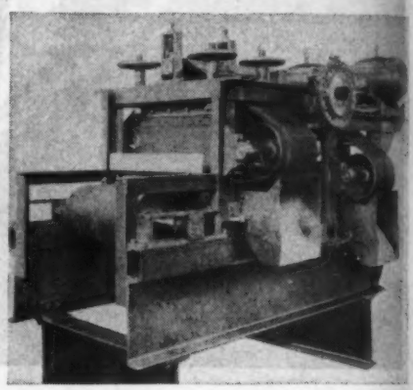
The Rapids-Standard Co., Inc.

Sales Division—370 Peoples National Bank Bldg., Grand Rapids 2, Michigan

erator, cross-flux exciter, constant-voltage exciter—all driven by an induction motor and d.c. hoist motor similar to type used in crane-hoist installations, except that its main field is for variable separate excitation. If used with d.c., a shunt-wound d.c. motor drives the generator and cross-flux exciter instead of induction motor, and the constant-voltage exciter may be eliminated. Speed changes are inherent in the drive, and do not depend on functioning of control devices. Braking is electrical. Industrial Engineering Div., General Electric Co., Schenectady 5.

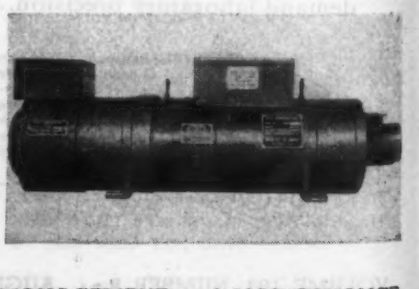
Magnetic Separator

High intensity dual cross belt electro-magnetic separator is designed to remove fine fuzz of iron from non-ferrous borings, and also can be used to reclaim abrasives from grinding wheels. Protects extrusion dies and cutting tools from iron slivers. Material to be separated is loaded into a hopper, from which it is distributed to first main belt by reciprocating feeder. When material passes through first and second magnetic zones, particles are lifted by upper magnets and pushed up by lower ones. There they are held fast to under surface of first cross belt that carries them beyond magnetic influence to be discharged at the side. First main belt discharges to second main belt, where material is turned over. It is then subjected to another magnetic treatment in third and fourth magnetic zones. Dings Magnetic Separator Co., 509 E. Smith St., Milwaukee 7.

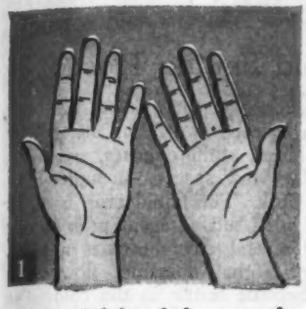


Motor-Generator Set

For applications where many d.c. voltages are required, sealed two-bearing motor-generator set, lightweight and space-saving, is announced. Unit has no sub-base, is semi-enclosed, drip-proof, and shock-proof, has five commutators and a pair of slip rings. Built for d.c. operation, it can be furnished with either d.c. or a.c. driving



It started with the other hand

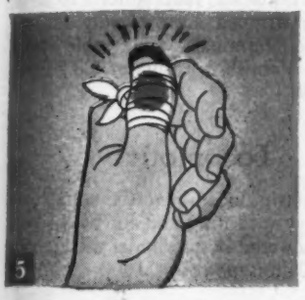


Right or left-handed, your *other* hand is a type of jig.

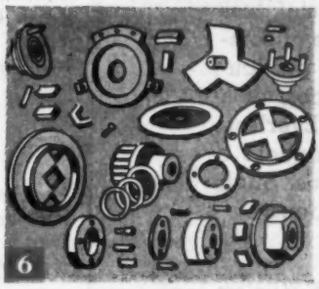
A jig is something to hold work while you're working on it.

Notches in stones or logs left both hands free.

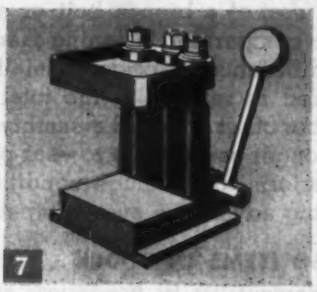
Two heavy stones once served as a sort of vise or jig.



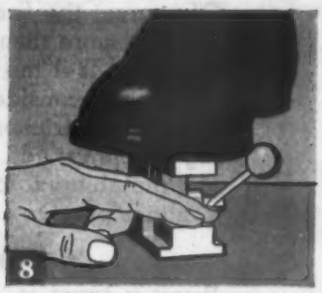
Modern adjustable jigs have two faults. Some slip, hurt people.



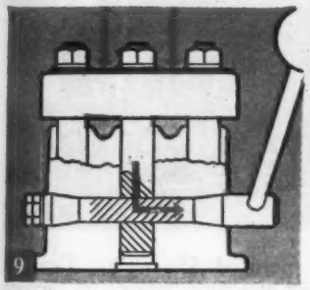
Locking mechanisms of others wear out fast or fail.



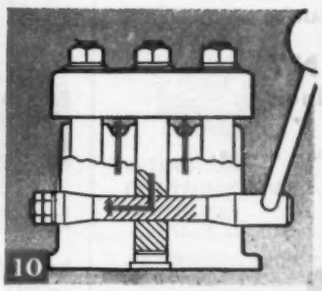
These problems were solved by Woodworth's CONE-LOK JIG.



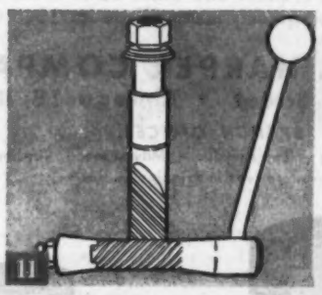
This amazing jig locks instantly. Can't slip. Protects workers.



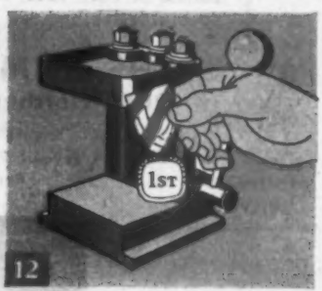
Force on top travels thru 45° gear to right. Left cone locks.



Force from below is transmitted to left . . . locks cone at right.



CONE-LOK JIG is simple. Three moving parts do the job.



CONE-LOK is praised by production men everywhere.

What Woodworth products mean to industry

THE contribution to mass production efficiency made by the CONE-LOK JIG is typical of all Woodworth products.

There is a reason for this.

Every Woodworth product must conform to the basic policy of this company . . . *to make only products which will benefit industry through increased production and reduced costs.*

This means that the great demand for Woodworth Tools and Gages will be continuing, especially in view of the coming battle for postwar markets.

And it means that Woodworth engineers have been charged with the responsibility of searching constantly for new ways to speed up and lower the cost of production, in connection with Woodworth products of the future.

The constant growth and expansion of the N. A. Woodworth Company is due to strict adherence to these objectives.

ACCURACY YOU W CAN TRUST

WOODWORTH

N. A. WOODWORTH CO., SALES DIVISION, 1300 E. NINE MILE ROAD, DETROIT 20, MICHIGAN

PRECISION GAGES

PRECISION MACHINED PARTS

PRECISION TOOLS

LOW COST Rust Prevention!

USE HARPER NON-FERROUS AND STAINLESS FASTENINGS

Rust is the Great Destroyer. Every year it causes damage of "war debt" proportions.

Fortunately, the cost of preventing rust and corrosion through the use of Harper Everlasting Fastenings is low. Of course, the first cost of a bronze bolt or a stainless screw is more than a comparable fastening made of common steel. Yet the difference in price is small, particularly when considered in relation to the total cost of a machine, instrument or other fastened assembly. Everlasting fastenings add longer service life to your product... and the ability to perform under tough conditions. Such qualities provide a big advantage over competition.

4360 ITEMS IN STOCK

Harper is known as "Headquarters for Non-Ferrous and Stainless Fastenings"... carries large and complete stocks of 4360 different items and is continually adding others... maintains large stocks of metals in bars, rods, wire, sheet and other basic forms from which special fastenings can be quickly made. Write for 1945 Catalog.

THE H. M. HARPER COMPANY
2651 Fletcher Street • Chicago 18, Illinois

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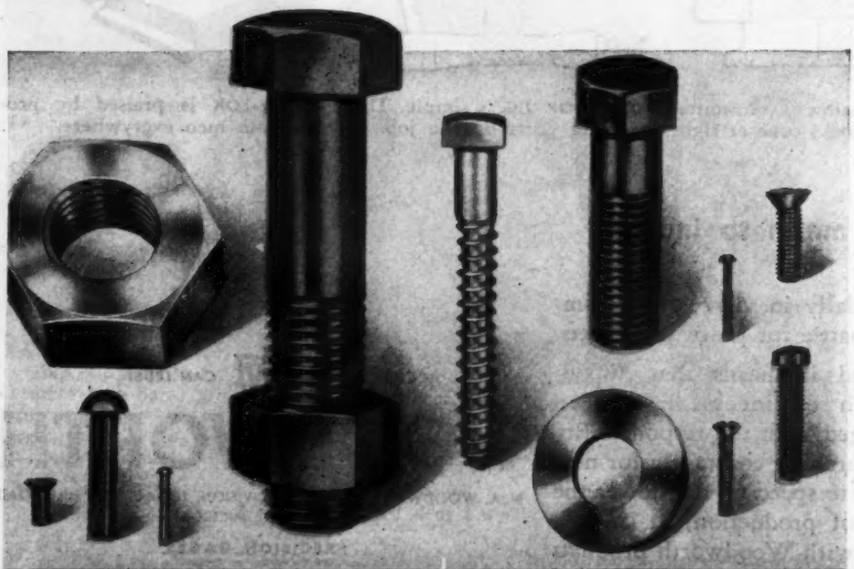


HARPER
EVERLASTING FASTENINGS

BRASS • BRONZES • COPPER • MONEL • STAINLESS

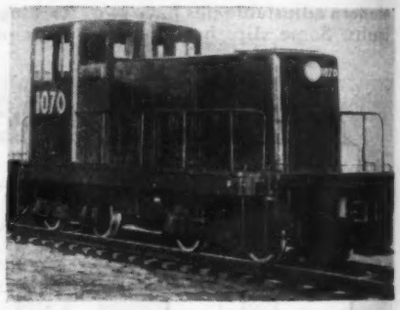
motors. Provides a.c. voltages and several different specified d.c. voltages from 12 to 2000 volts, regulates voltage, and meets low ripple requirements. Terminal boards are contained in shock-proof housing mounted on top of unit for easy accessibility. Bogue Electric Co., 40 Kentucky Ave., Paterson 3, N. J.

Cold Setting Plastic

A cold setting plastic, called Cardolite 5616, can be used as a filling material for junction boxes, stuffing boxes, pot-heads, and similar void spaces encountered in electrical work. The liquid resin is mixed with No. 5612 setting agent prior to use, and after several days becomes a tough rubbery mass that does not flow under heat, or become brittle in the cold. The set compound is insoluble in water, oil, acids, and alkalis, according to maker. Although Cardolite 5616 adheres to metal, it can be stripped away cleanly to allow repairs to terminals and cable strips. Irvington Varnish & Insulator Co., Irvington 11, N. J.

Locomotive

Diesel-electric locomotive is suitable for both heavy yard duty and for road service. Unit is powered by 6-cylinder diesel engine rated 660 horsepower at 1000 r.p.m., and



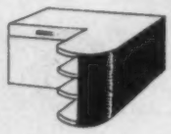
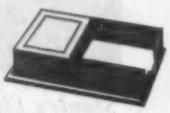
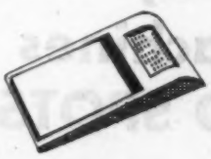
has top speed of 55 m.p.h. The four motors and generators making up the electric drive are designed on same basic principles used in larger Alco units. General Electric Co., Erie, Pa.

High Vacuum Gage

Redesigned McLeod type portable high vacuum gage is announced, with which accurate readings within the micron range are stated obtainable, even when condensable vapors such as water, oils, and alcohol are present in vacuum systems. Compact built-in renewable chemical cartridge protects instrument by absorbing the vapors. Change of color in chemicals indicates when cartridge renewal is necessary. Other features are a simple device for fine adjustment of automatic zero point; shut-off valve to keep gage under vacuum without contamination when not in use; slotted bracket permitting removal of gage for different mounting; fittings that minimize amount of rubber tubing or other connections which could give rise to leaks; and plastic case. Gage is said to be as easy to read as a thermometer. Available in two portable models, 0 to 5000 microns

Plastics

IN OFFICE EQUIPMENT

LAMINATED	NAMEPLATES	 DESKS	BUSINESS MACHINE TABLE TOPS	DESK LAMP SHADES
PHENOLIC	PEN SET BASES	CASTERS	DUPLICATOR HOUSINGS	 MEMO PAD HOLDER
UREA	INTEROFFICE COMMUNICATION HOUSINGS	 CALENDAR PADS	CLOCKS	LIGHTING BOWLS

TO REACH A SOUND CONCLUSION TO YOUR PROBLEM IN PLASTICS consult the skilled technicians—engineers and designers—of the General Electric Company. For advice on the successful application of plastics materials using all available processes of manufacture, write Section I-32, General Electric Company, One Plastics Avenue, Pittsfield, Mass., or call the General Electric Plastics Divisions' office nearest you.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS. "G-E House Party" every weekday 4:00 P.M. EWT, CBS.

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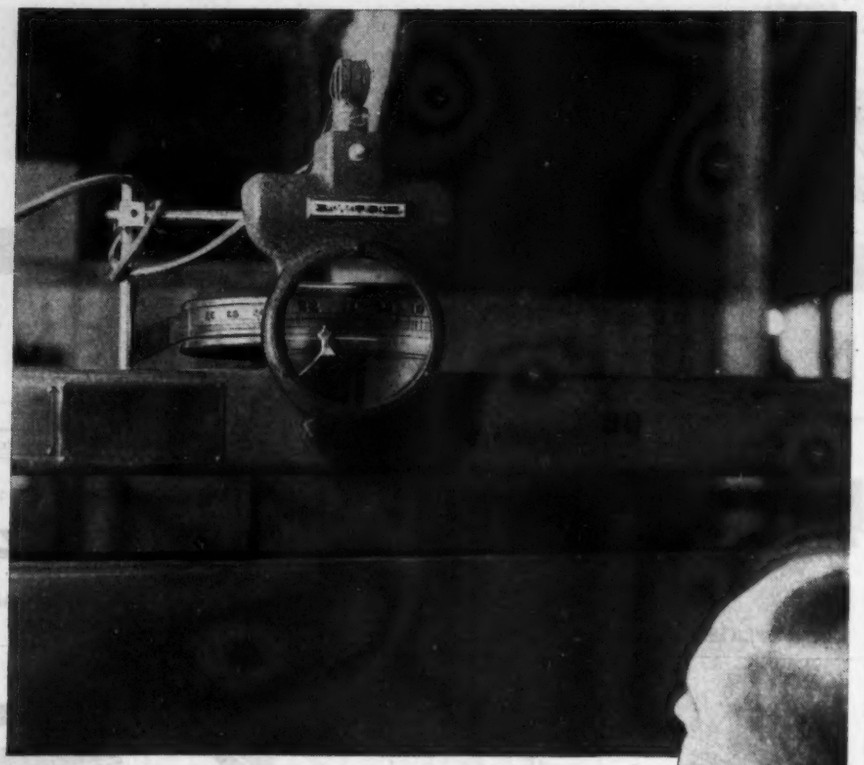
EVERYTHING IN Plastics

BUY WAR BONDS

GENERAL ELECTRIC

PD-32



Stanley Flud-Lite Magnifiers on machines give extra attention value to vital gauges.

How many of YOUR machines have BLIND SPOTS?

Turn a Stanley "Flud-Lite" Magnifier on that gauge, indicator, level or observation window and watch that blind spot disappear! With the "Flud-Lite" Magnifier you get magnification through a high quality 5" lens *plus* shadow-free fluorescent light – a combination that provides instant readability and eliminates eyestrain. Used on machines, on the inspection bench, or for assembly of small parts, Stanley "Flud-Lite" Magnifiers help increase production by supplying better visibility on the job. Write today for illustrated folder. Stanley Electric Tools, Division of The Stanley Works, New Britain, Connecticut.

STANLEY

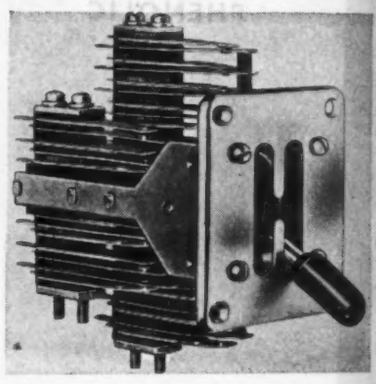
No. 701. *Bench type Stanley Flud-Lite Magnifier. Steel base is removable to permit attachment of Magnifier to machine or fixture.* **No. 701H.** *Portable type Stanley Flud-Lite Magnifier.* **No. 05.** *Stanley Auxiliary Lens, a powerful 2½" lens, which added to the Stanley Flud-Lite Magnifier, doubles its power.*

STANLEY ELECTRIC TOOLS

(5 mm.) and 0 to 500 microns, for plant or laboratory. F. J. Stokes Machine Co., Philadelphia 20.

Lever Switch

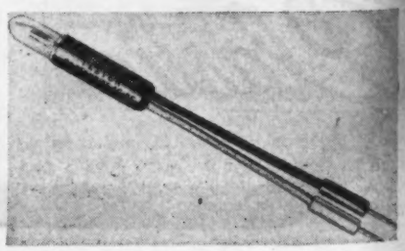
Multiple position, multiple circuit, positive action Series 4500 heavy-duty lever switch is announced. Known as Gear Shift Switch, it is available in either four-position (Series 4504), or five-position (Series 4505) assembly. In all positions except center (neutral), the action may be locking or non-locking. In center position it



is always locking. Switch can be used for safety selective switching as well as for emergency transfer of spare equipment, in which special locking arrangement prevents use without breaking seal. Motor starting, stopping, reversing, and speed control; hoist and crane control; and equalization of multi-generator operation are other applications. Donald P. Mossman, Inc., 612 North Michigan Ave., Chicago.

Circuit Tester

All-purpose circuit tester is vest-pocket type, and indicates voltages from 90 d.c. and 60 a.c., to 500 volts a.c. or d.c. Neon lamp on top glows in varying intensities, indicating circuit conditions; no glow in-



"Sunday Punch" that Travels 15 Miles!

When "Long Tom"—155 mm. heavyweight of the battlefront—hurls his 95-pound shell at an enemy 15 miles away, he delivers the "Sunday Punch" of our hard-hitting field artillery. And he throws 3 of these long-range, knock-out punches a minute.

Yet with all of its striking power, this gun is highly mobile, especially when mounted on a Sherman tank chassis, as pictured below.

Because of the tremendous pressure and strain generated upon firing, "Long Tom" barrels and breech blocks are made of the finest steel obtainable—Electric Furnace Steel. Made to exacting specifications, much of this steel has come from Republic.

Republic Electric Furnace Steels top the list for strength and toughness—and for favorable strength-to-weight ratio. And the close control possible only in electric furnace melting keeps them *ALWAYS* "on target," enabling them to hit predetermined specification marks smack on the nose.

These steels are as *CLEAN* and *SOUND* as the most expert furnace practice can make them. They are *consistently UNIFORM*—in physical, chemical, hardenability and performance values. They are free from imperfections which might initiate cracks and lead to dangerous failures. And they are free from practice-upsetting variables—thus insuring full benefits from mass production.

Republic—world's leader in this field of steel making—is ready NOW to help you improve the quality of your peacetime products and cut manufacturing costs with Republic Electric Furnace Steels. Write to:

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Bldg., New York 17, N. Y.

Signal Corps Photo

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—Leader in the Production of
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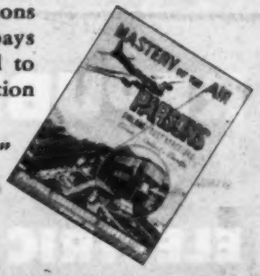
"QUALITY" steels . . . alloy . . . stainless

IS YOUR PLANT EQUIPPED FOR POST-WAR COMPETITION?

Reclaim Valuable Dust . . . Increase Production

WITH PARSONS OVAL BAG DUST ARRESTORS . . . Now is the time to give serious thought to your plant and equipment. Post-war competition will be keen, with demands for greater production, and working conditions that take into consideration the health of your employees. Dirt and dust deteriorate equipment . . . slow up production . . . decrease employee efficiency. This costly element can be eliminated with Parsons Oval Bag Dust Arrestors. Improved plant efficiency, plus lower maintenance cost on equipment, will prove that Parsons Dust Arresting Equipment actually pays for itself. Our engineers will be glad to make recommendations without obligation . . . write today.



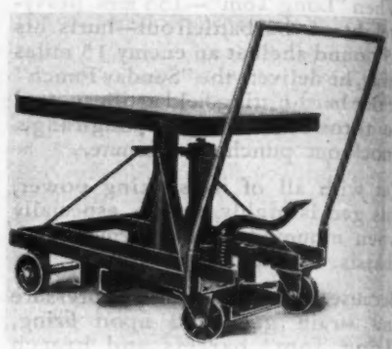
Write for booklet "Mastery of the Air"

Parsons — CREATIVE ENGINEERS MANUFACTURERS — ENGINEERING CORP.
2545 EAST 79th ST. CLEVELAND 4, OHIO

dicates dead line. Lamp lights on currents as low as one microampere. Tester is applicable for locating blown fuses, trouble shooting in cords and appliances, testing radio frequency, receivers, plate circuits, and screen grids; for testing spark plugs, meters, condensers, and armatures. Traces grounded lines, open circuits, short circuits, and various conditions. Amerline, 1753 North Honore St., Chicago 22.

Elevating Table

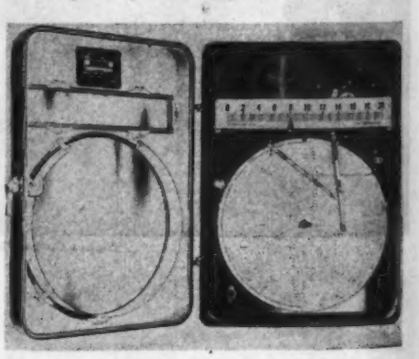
Heavy material and dies are raised to a level convenient for operator, and sheets are lifted for press feeding, with hydraulic elevating table. Operation is by mechanism using foot pedals. Running gear consists of two rigid and two swivel roller and ball



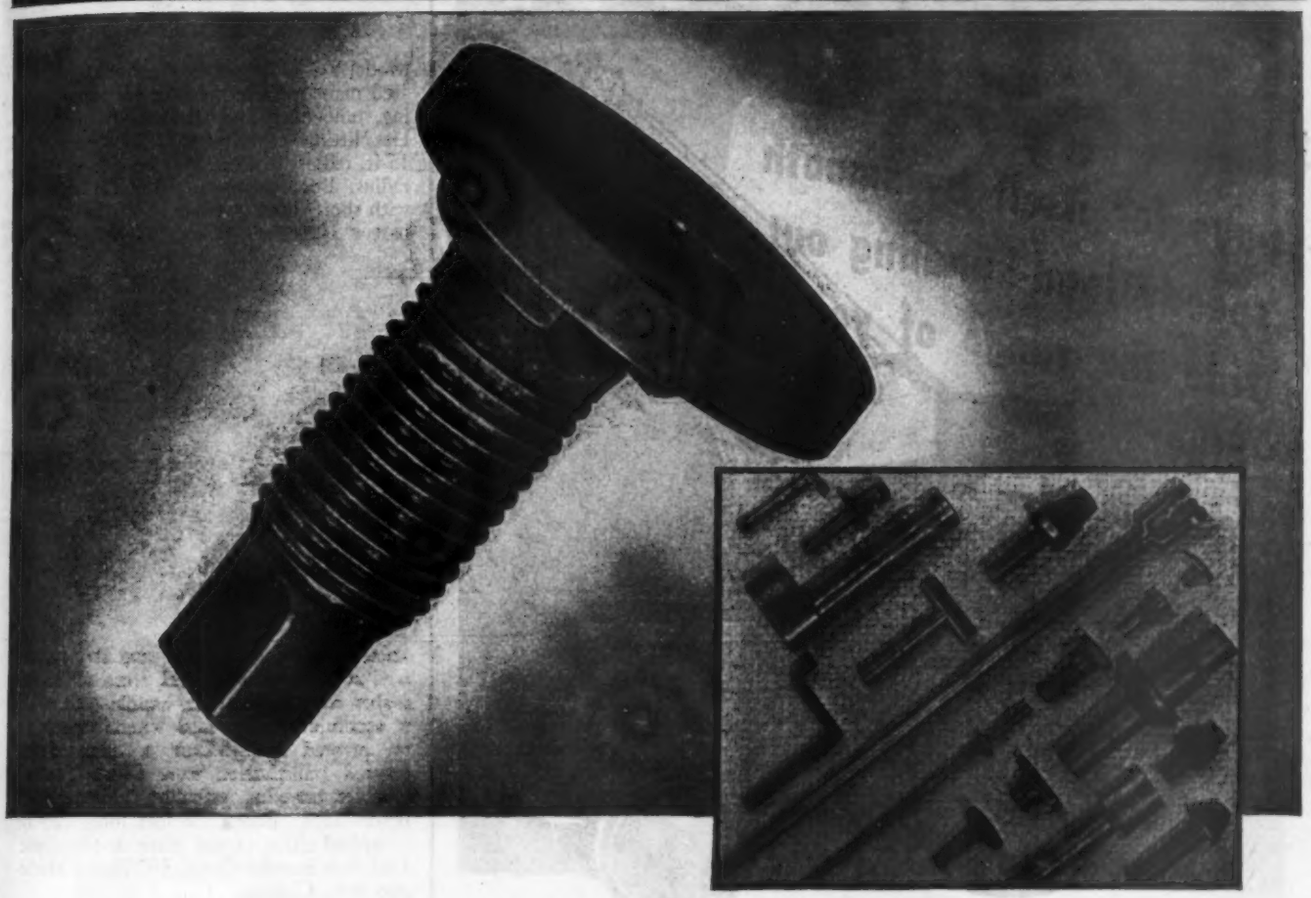
bearing casters of semi-steel or composition rubber tires. Removable push bar is furnished with the table. Platform is smooth steel, but reversible roller and ball transfer tops are available. Revolvator Co., North Bergen, N. J.

Potentiometer Controller

Five basic electric-type potentiometer controllers have been developed. Three are electric contact types known as the Microact controllers and the other two are electric proportioning and current input models. Control units are mounted on the internal panel of the Pyromaster potentiometer recorder and any type may be converted to any other type by simple wiring and mounting. The Microact units are provided with one, two, and three precision-type toggle switches respectively and six different terminal board connection arrangements to meet diverse control circuit requirements. Proportioning controllers may be used with any type of electric proportioning valve with which resetting contacts are available. The proportional current input controller is primarily to provide



100 YEARS *Making strong the things that make America strong*



COLD-FORGING solves many problems

. . . of strength . . . of accuracy . . . of appearance . . . of cost

There are various reasons why cold-forging was selected as the best or perhaps the *only* efficient method of producing these parts.

Some were cold-forged in order to obtain maximum *strength*. Proper cold-working definitely increases tensile strength and also provides an automatic inspection of the material.

Others were cold-forged because *accuracy* of dimension and fine *appearance* were paramount considerations. That modern cold-upsetting equipment can meet such specifications is evidenced by the billions of fastening parts for aircraft service that have been made by this method.

And in many cases, the *economy* of the method made it attractive. The high speed of RB&W's cold-forging machinery reduces cost below that of other methods which require several or slower operations. With practically no scrap waste, there is also a saving in weight of metal required.

100 YEARS EXPERIENCE

1945 marks RB&W's 100th year in the production of high-quality fastening products. Its experience in automatic cold-forging—the longest of any manufacturer—will be helpful to you in determining the most efficient means of obtaining parts like those shown above. Plan to make use of RB&W facilities when they are again available upon completion of war assignments.

RB&W

Russell, Burdsall & Ward Bolt and Nut Company . . . *Factories at* Port Chester, New York, Coraopolis, Pa., Rock Falls, Ill., . . . *Sales offices at* Philadelphia, Detroit, Chicago, Chattanooga, Los Angeles, Portland, Seattle . . . with the industry's most complete, easiest-to-use catalog.

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

ROUSTABOUT CRANE

pays for itself by smooth speedy load-handling outside the range of your other equipment—

The Free-roving, Tractor-footed Crane of a hundred uses

POST-WAR competition is going to call on you for greater efficiency and lowest possible costs. That means the speed and economy of machine power, which hundreds of Roustabout Crane users in many industries have found in this handy powerful load-handler. Ready for instant use where needed, it moves, loads, stacks heavy stuff to 7½ tons all around your plant, prevents costly delays or shifting men to meet emergencies. Easy to operate, built for years of overwork — ball-bearing boom turntable, all gears in oil. Get the facts *now* on this fast-action mobile wheel or crawler crane.

Roustabout saves you time and money on these and many other jobs

- Big stuff off and on trucks, freight cars
- Moving large machines
- Handling bales, boxes, drums
- Moving big castings, motors, railroad and marine gear
- Loading air transport planes
- Handling tanks, pipe, structural steel
- Installing heavy valves and fittings

ARMY E NAVY

THE HUGHES-KEENAN COMPANY
623 Newman Street, Mansfield, Ohio

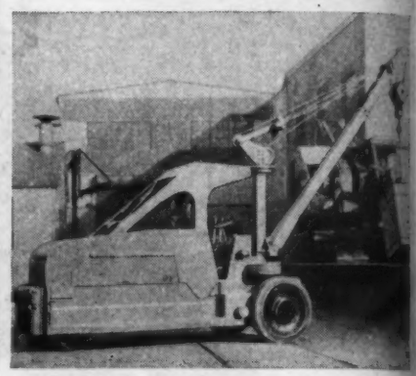
ROUSTABOUT CRANE

Roustabout Cranes
By Hughes-Keenan
Load-Handling Specialists Since 1904

close temperature control of electric furnaces and ovens. The Bristol Co., Waterbury 91, Conn.

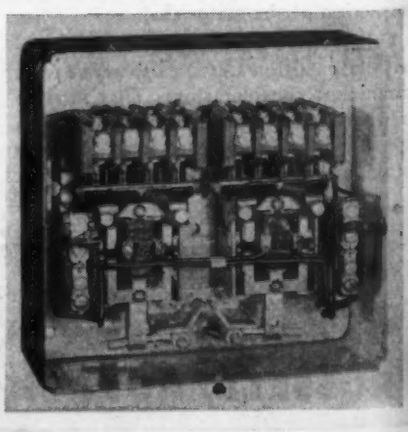
Crane

Model YC-5 Cargocrane is a one-man operated maneuverable machine for rapid loading, unloading, and stacking of materials. Has lifting capacity of 2900 pounds at 15-ft. radius up to 15,000 pounds at 3½-ft. radius. Boom swings in a full 210 degrees, with short turning radius of chassis. Wheel base is 10 feet, 9 inches. Hydraulic operation of swing mechanism and steering, as well as clear view of work from all angles makes machine easy to handle. Steering is accomplished by dual wheels operating on pivoted axle. Unit is operated by 3-speed transmission from 57-hp. gas engine for traveling, swinging, hoisting, and boom hoist. Boom, 20 feet long, can be furnished either in one piece or telescopic. Link-Belt Speeder Corp., 307 North Michigan Ave., Chicago.



Starter

Featuring semi-interference-type mechanical interlock, a.c. magnetic reversing starter is announced. Available in sizes 0 and 1, the device is designed for full voltage starting of squirrel-cage induction motors, and can be used for reversing service when combined with reduced voltage starter. Adjustable semi-interference-type mechanical interlock prevents closing of one contactor while an arc is maintained on the other, thereby averting short circuit through the arc, and resultant burned contacts and blown fuses. In addition, interlock arm of closing contactor assists interlock arm of opening contactor in reaching

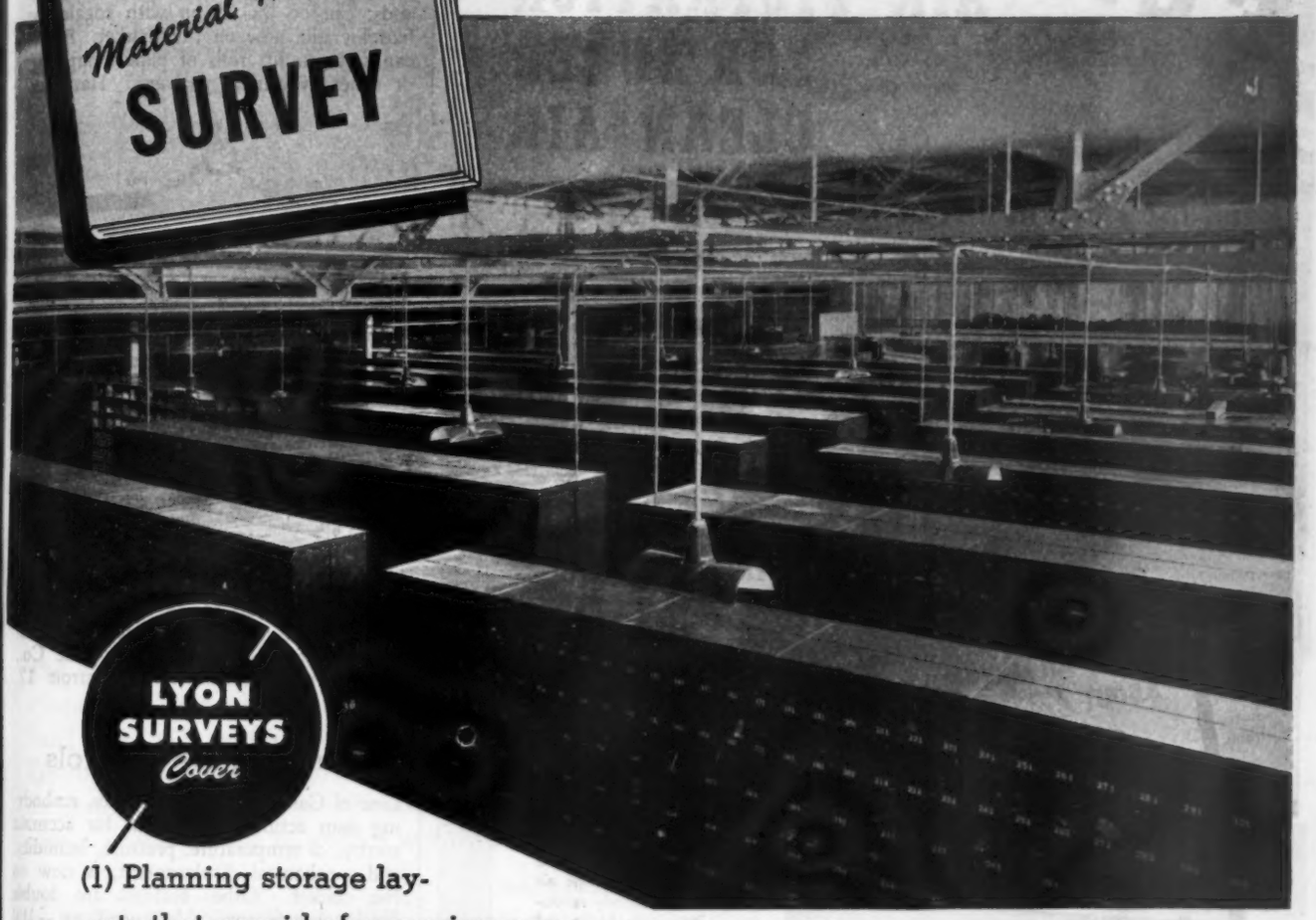


LYON

Tool Cribs
Store Room
Material Handling

SURVEY

...for SMOOTHER CONVERSION to *Essential Civilian Production*



LYON SURVEYS *Cover*

(1) Planning storage lay-outs that provide for maximum use of a minimum inventory, save time and floor space; (2) Organizing tool cribs to make possible more productive hours from every available die and small tool; (3) Selecting shop containers of the most efficient type and size for fast, safe handling of materials in production.

A Lyon Survey may be put to work immediately for faster handling of a vital war job. And it can be used when quick reconversion becomes a big factor in speeding up essential civilian production . . . in organizing for winning post-war markets, etc. . . . Lyon Survey Service is offered without obligation. Write us for full details.

WHAT ABOUT POST-WAR?
Do your post-war products include sheet metal or aluminum? Check Lyon's manufacturing and designing facilities.

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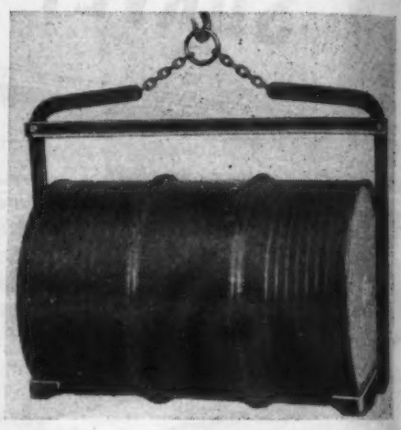
fully opened position. Provides under-voltage protection when used with push-button station or other momentary pilot-circuit device; undervoltage release; and tamper-proof, self-contained overload relays. Industrial Control Div., General Electric Co., Schenectady 5.

Barrel Cradle

Barrel or drum of any shape, with straight or bilged sides, and with flat or chimed ends, can be picked up with toggle-type barrel cradle now on the market. It also can serve to lift rolls of paper, carpeting, or other cylindrical packages. Has a ca-



pacity of 1000 pounds, and is made of heavy bar stock, welded construction. Handles units 20 to 25 inches in diameter and 32 to 36 inches long. Special sizes can be obtained. Palmer-Shile Co., 7110 West Jefferson Ave., Detroit 17.

Temperature Controls

Line of Cam-Stat control devices, embodying snap action arrangement for accurate control of temperature, pressure, humidity, and mechanical displacement, is now on the market. Other features are double break contacts, applicable range from —100 to +600 deg. F., enclosed contacts, single pole single throw, single pole double throw, or independent circuit double throw, resistance to vibration, low thermal lag. Unit is tamper-proof, adaptable to any mounting means, and has contact openings from 0.010 to 0.060 inch. Operating parts are in balance thermally as well as geometrically, and accuracy of calibration is not affected by underheat or over-

Take SWITCHBOARDS out of the "SPECIALTY" Class

KLAMPSWITCHFUZ

The FA Klampswitchfuz safety type switchboard is completely enclosed. Its hinged doors contain both switch and fuse in one unit and close in "on" and "off" positions. Heavily silvered copper contacts are *squeezed** together in one locking motion that clamps fuses at the same time. Fuses are instantly accessible on the *outside* when doors are open — where hands cannot possibly come in contact with live parts.

Build Your Switchboard with "Standard Units"

You receive the savings from quantity production of standard pre-assembled units, and you can't find a *better* switch at any price. Stripped of the attachments that break, stretch, or wear out—that add to the cost but not to the efficiency—these units are *built to give trouble-free service year after year*.

Flexible, too, for changing plant conditions: full panels can be added or removed quickly, without loss of valuable production time. Completely assembled at the factory, they come ready to be installed.

CAPACITIES

FA Klampswitchfuz units are made in capacities of 30 to 1800 amperes, 250 volts AC and DC—30 to 600 amperes, 575 volts AC, in 2, 3 and 4 pole types, single and double throw. Approved by Underwriters' Laboratories, Inc., as operating switches for 600 amperes and less, 250 volts AC and DC, and 200 amperes and less, 575 volts AC. All others approved as disconnect switches.

Note the simple, sturdy construction of the 3 pole, 200 ampere unit.

See our listing in "Sweet's," or write for name of nearest FA Representative.

*Compression contact on 200 ampere capacities and less—FA Kamklamp fuseholders on 400 ampere capacities and up.

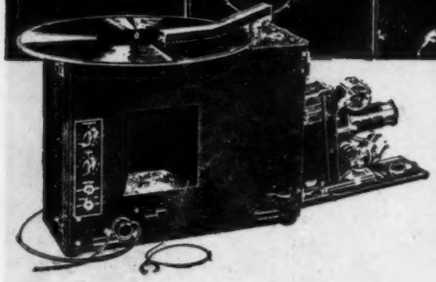
Frank Adam
ELECTRIC COMPANY
P. O. Box 357 • St. Louis, Mo.

Makers of Busduct, Switchboards, Panelboards, Service Equipment and Enclosed Switches

The One Best Way

For a 2-Way Task

ILLUSTRAVOX TELLS and SELLS THEM



In all types of training Illustravox sound slidefilm equipment is the most effective . . . the least expensive.

In introducing new products Illustravox reaches salesmen, distributors and potential buyers, telling your story in attention-arresting pictures and spoken words.

ILLUSTRAVOX is the scientific training method . . . a portable, inexpensive sound slidefilm projector using records and slidefilm to present your exact and perfected training message in authoritative pictures and spoken words.

Cuts Training Time

●● *Already field-tested and proved before the war by leading industrial concerns, Illustravox efficiency was further proved in military training programs. Accelerated courses were cut from as much as* six months to six weeks! *Trainees remembered up to 25% longer than under former training methods. Over 75% of all sound slidefilm equipment now in use is Illustravox.*

Compact—easy to carry

Complete Coverage

●● In introducing new products, as in training, Illustravox saves vital man-hours. With Illustravox presentation your story can be told everywhere at the same time . . . always the same . . . always accurate.

●● **Commercial film producers** *are experienced in the writing and production of film and recordings for use with Illustravox. You will also find the Illustravox booklet, "The Illustrated Voice" helpful in planning your postwar training program. Write for it today. The Magnavox Company, Illustravox Division . . . Department FM-8 . . . Fort Wayne 4, Indiana.*

ILLUSTRAVOX

THE ILLUSTRATED VOICE

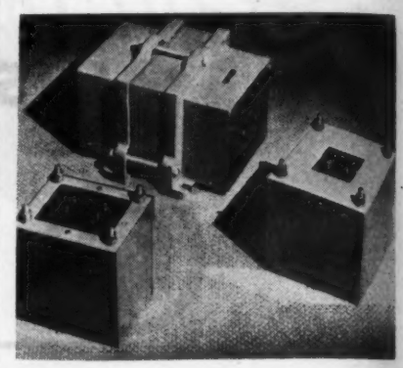
DIVISION OF THE **Magnavox** COMPANY • FT. WAYNE

MAKERS OF FINE RADIO-PHONOGRAPHS

heat conditions. Controls are adjustable, furnished with operating differentials running down to 1 deg. F., and can handle substantial loads. The Paul Henry Co., Thermal Div., 2037 South La Cienega Blvd., Los Angeles 34.

Transformers

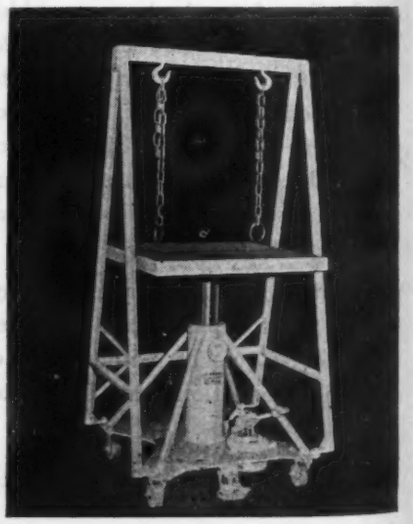
Three continuous duty transformers incorporate heavy lugs on black bakelite terminal boards. Types 800 and 801 also are available in hermetically sealed units to Army-Navy specifications. Model 800-A, primary 220 volts, 60 cycles; secondary 110 volts, 250 watts; 5AS case, 4⅝x3⅛x

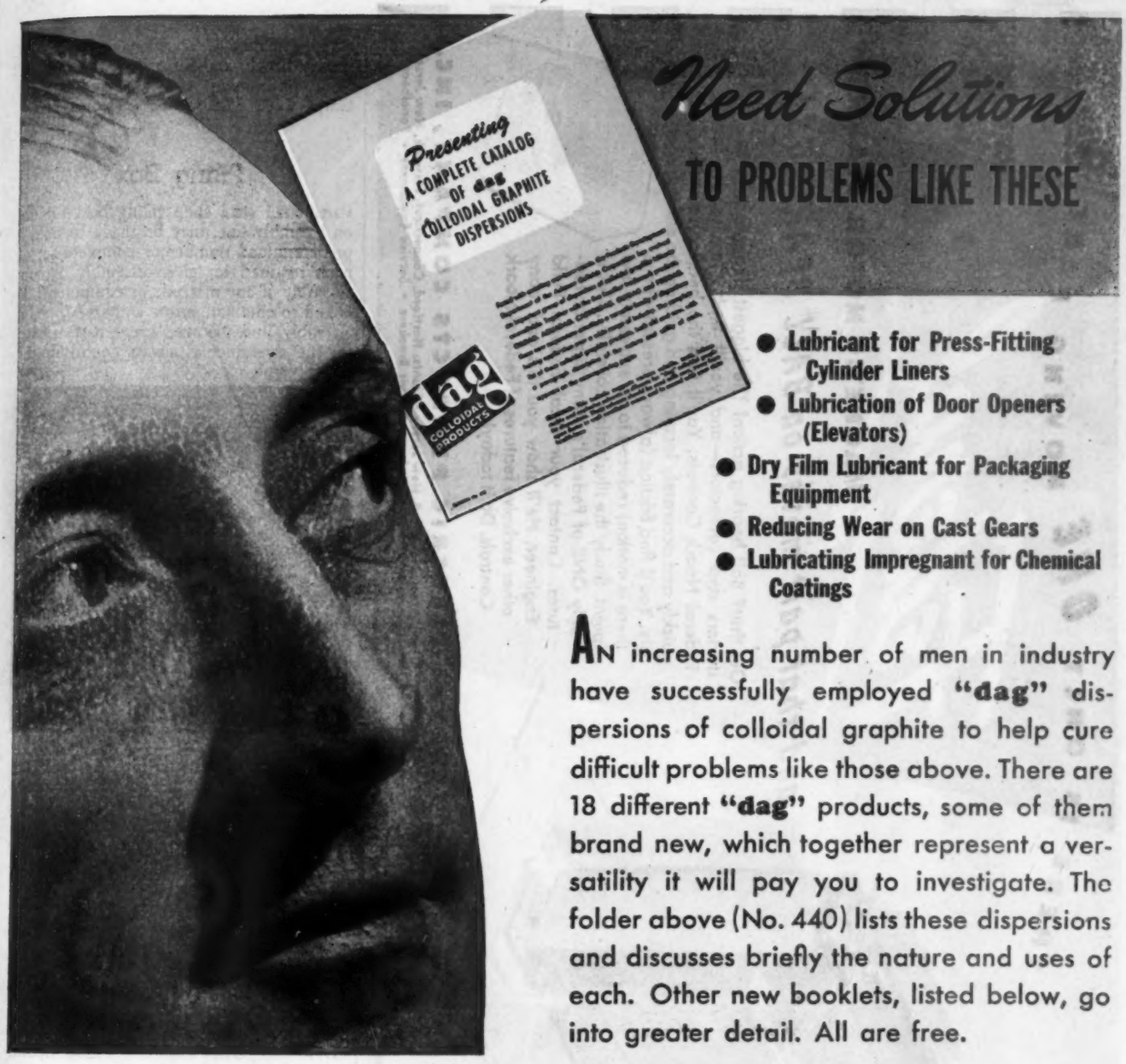


5 inches. Type 801-A, primary 220 volts, 60 cycles; secondary 110 volts, 500 watts; 6AS case, 5⅛x4⅛x5 inches. Type 802-A, primary 220 volts, 60 cycles; secondary 110 volts, 1000 watts; housed in No. 6 casting poured with humidity-proof compound, 9¼x7¼x6¾ inches. The Langevin Co., Inc., 37 West 65 St., New York.

Die Separator

Consisting of tubular superstructure that fastens to base of table by four bolts with wingnuts, die separator is optional feature for portable hydraulic elevating table. Dies are separated by elevating table top, fastening top section of die to superstructure with chains, then lowering table top with the bottom section of die. Separator is readily demountable, allowing use of table for such work as transferring dies in and out of presses, for support of over-





Need Solutions
TO PROBLEMS LIKE THESE

- **Lubricant for Press-Fitting Cylinder Liners**
- **Lubrication of Door Openers (Elevators)**
- **Dry Film Lubricant for Packaging Equipment**
- **Reducing Wear on Cast Gears**
- **Lubricating Impregnant for Chemical Coatings**

AN increasing number of men in industry have successfully employed **"dag"** dispersions of colloidal graphite to help cure difficult problems like those above. There are 18 different **"dag"** products, some of them brand new, which together represent a versatility it will pay you to investigate. The folder above (No. 440) lists these dispersions and discusses briefly the nature and uses of each. Other new booklets, listed below, go into greater detail. All are free.

dag colloidal graphite

ACHESON COLLOIDS CORPORATION, Port Huron, Michigan

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This new literature on **"dag"** colloidal graphite is yours for the asking:

430	A general booklet on the story of **"dag"** colloidal graphite. 12 pages profusely illustrated.
440	A complete list of **"dag"** colloidal graphite dispersions with applications.
421	**"dag"** colloidal graphite for ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY.
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423	**"dag"** colloidal graphite as a HIGH TEMPERATURE LUBRICANT.
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No. 432 ☐ (Lubricants containing **"dag"** colloidal graphite are available from major oil companies.)

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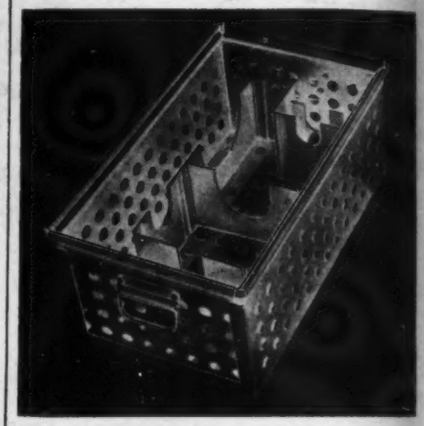
Federal NOARK MAGNETIC MOTOR STARTERS
and that part moves on BALL BEARINGS!
Get that? Ball bearing action! The biggest single feature in starters and contactors—and you'll find it exclusively in Federal Noark Controls. You'll find the bearings smoothly, quickly and accurately locating and guiding the entire assembly. You'll find friction (always present where there is motion) reduced to an extremely low point. Study the illustration carefully. This is only ONE of Federal's many superior features. Contact your local Federal Field Engineer. He'll show you this and many other exclusive features of Federal Noark Controls. Do it today!
BALL BEARINGS
The section in red represents the only moving part of the Federal Noark Magnetic Motor Starter. Simplicity - itself!
FEDERAL ELECTRIC PRODUCTS COMPANY, INC.
Executive Offices: 30 Park Street, Newark 5, New Jersey • Plants: Hartford, Connecticut; Newark, New Jersey
Manufacturers of Motor Controls • Safety Switches • Circuit Breakers • Service Equipment • Panelboards

hanging materials, as adjustable height assembly bench, and for other handling and work positioning tasks. Lyon-Raymond Corp., 2282 Madison St., Greene, N. Y.

Piling Box

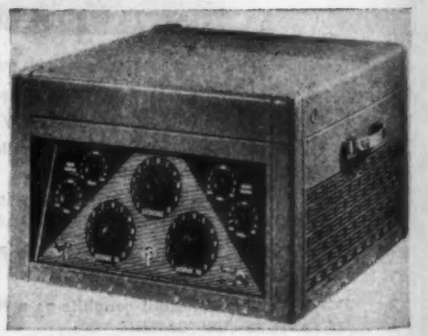
Partitioned steel shop piling box, for use on assembly line, may be made to hold a predetermined number or complete set of parts required for given assembly or subassembly of any machine or equipment. It is said to eliminate errors and save time on assembly line, because every part needed by the assembler is always found in the



same pigeonhole in the box. Filled to capacity, boxes contain the exact number and the right sizes for a given purpose. Partitions may be fixed or removable, freeing boxes for conventional uses when not needed for assembly function; or box may be converted for use on new or different models by re-placing partitions. Shop Equipment Div., Cleveland Wire Spring Co., 5250 Brookpart Rd., Cleveland 9.

Dual Amplifier

A 40-watt dual amplifier, called Soundcaster, is for either plant broadcasting or public address service. Features a switch for selection of public address mixing or plant broadcasting. Panel switch permits pre-set volume selection of voice-paging, music or remote microphone. Model 1335 is engineered for continuous heavy-duty use. and Model 531 incorporates 2-speed,



manually operated record player for 10- and 12-in. commercial recordings, or 16-in. transcriptions. No. 530 has automatic record-changing mechanism for twelve 10-

"whew! imagine the dish-washing in a war-plant without—DIXIE CUPS

"We women are a bit sensitive when it comes to cleanliness about food and drink, fussy about putting our lips to something that has previously been used by others. Maybe that's why Dixie Cups on our war jobs mean so much to us women."

DIXIE CUPS, VORTEX CUPS AND PAC-KUP CONTAINERS ARE MADE AT EASTON, PA., CHICAGO, ILL., DARLINGTON, S. C., TORONTO, CANADA

INLAND 4-WAY FLOOR PLATE

You get greater safety, structural strength, and long life when you install Inland 4-Way Floor Plate.

Its special 4-way pattern helps prevent slipping and falling by men, and skidding by trucks. It has all the structural strength and long wearing qualities of rolled steel. It naturally will not rot, splinter, warp, or absorb moisture or odors. And, it is easily cleaned.

Write for Bulletin

INLAND STEEL CO.

38 S. Dearborn St., Chicago 3, Ill.

Sales Offices: Cincinnati • Detroit • Kansas City • Milwaukee
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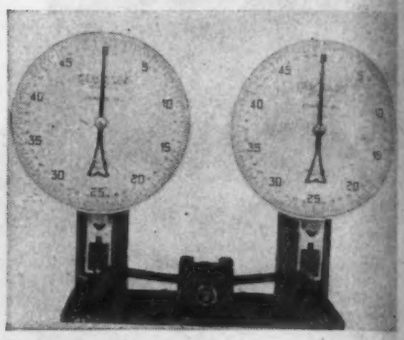
in. or ten 12-in. recordings. Recessed pilot lights illuminate panel controls for microphones, recordings, paging, and bass and treble response. Operadio Mfg. Co., St. Charles, Ill.

Torque Tester

Tester is presented for checking torque wrenches, measuring torque necessary to screw and unscrew threaded parts, determining starting torque of motors, testing elastic couplings, and other applications requiring checking of torques. Use of the instrument makes it possible for unskilled worker to make adjustments. Made in

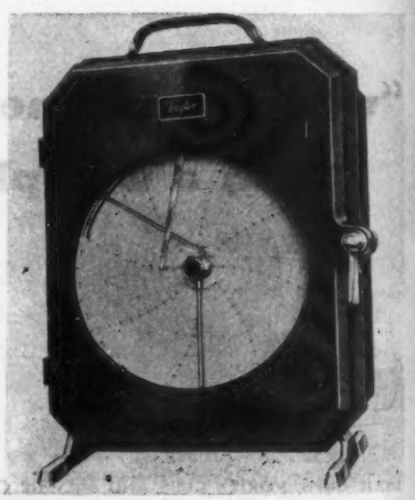


range of capacities from 50 inch-ounces graduated by ½ inch-ounces up to 1000 foot-pounds graduated by 5 foot-pounds. Tester is operated by applying torque to shaft registering resulting force directly on dial. Shaft can be provided with pin, vise, adapters, or other fittings to suit application. John Chatillon & Sons, 85 Cliff St., New York 7.

BACK ON THE MARKET

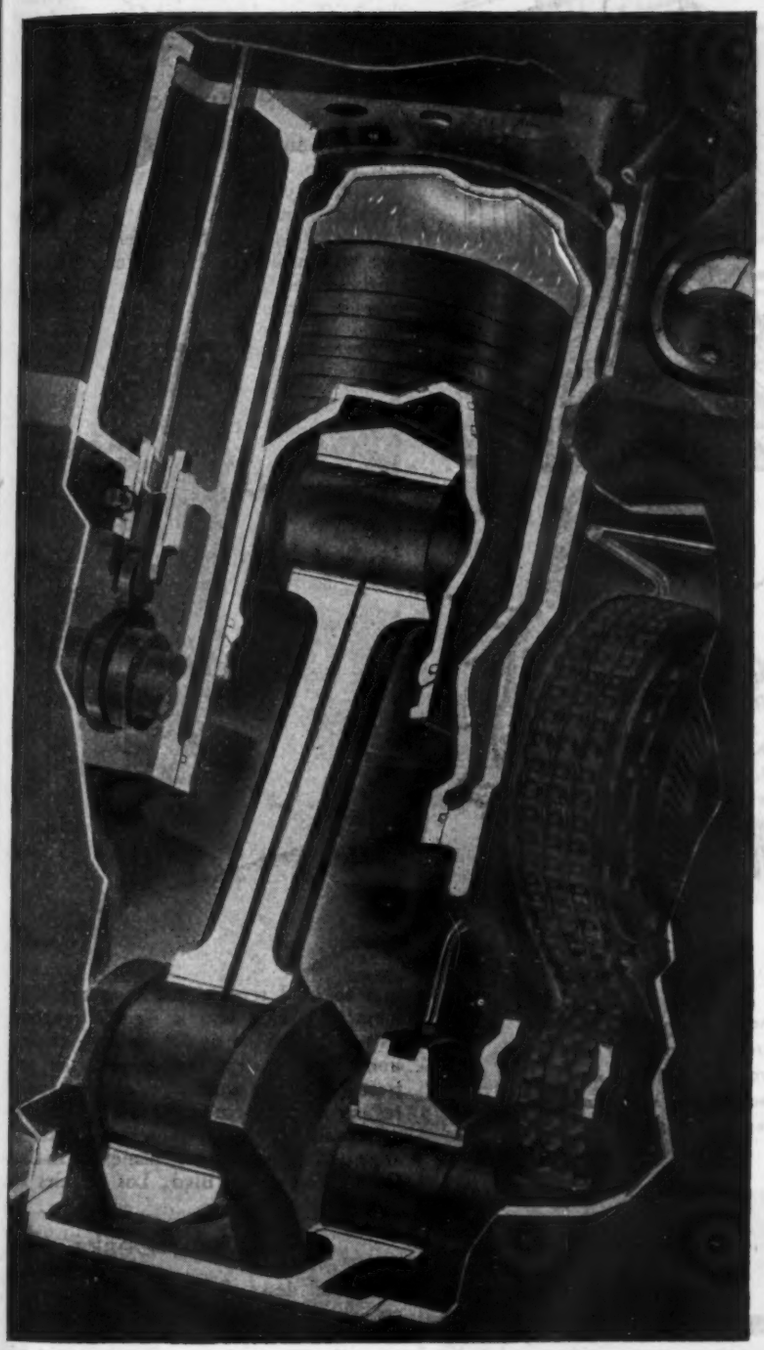
Portable Recording Thermometer

Self-contained portable recording thermometer, now back on the market, is a standard model, except for the temperature-measuring system, and feet and carrying handle. Suitable for use in boiler rooms, enameling and japanning ovens, engine and refrigerating rooms, as well as in chemical, food, and air conditioning plants. Preformed capillary bulb attached



LOOK INSIDE THE *Machine* FOR NEW ECONOMIES IN ANY INDUSTRY

The Heat's On—for engines and executives!



TODAY'S pressing production schedules still call for full power inside your engines and careful planning on your part to keep *all of your machines* at peak output.

This cutaway picture of a Diesel engine shows the importance of correct lubrication to this effort. Above that plunging piston, combustion heat flashes to 3,500°F. The pressures are terrific. Socony-Vacuum has perfected special Diesel Oils that stand up under these conditions, keep rings from sticking, prevent loss of power, protect vital parts from wear.

The same is true for giant turbines, steam engines and production machines of all types. Gargoyle Oils and Greases assure maximum protection of all moving parts, continuous production at low maintenance costs. Just as important, Socony-Vacuum's Complete Lubrication Service for your plant gives you the five extra benefits listed below.

Call now for this unbeatable combination!

SOCONY-VACUUM OIL COMPANY, INC. and Affiliates: Magnolia Petroleum Company, General Petroleum Corporation of California.

Call in SOCONY-VACUUM *for Correct Lubrication*

GARGOYLE Lubricants

Socony-Vacuum's 5 STEPS to Lower Production Costs for You!

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured

HE WANTS TO BUY IT BACK NOW—HE'S LEARNED IT'S MADE WITH ROEBLING CABLES
ROEBLING'S ELECTRICAL CABLES, WIRE SCREEN AND STRIP STEEL ARE GOOD INVESTMENTS, TOO.
BILL OF SALE TO BROOKLYN BRIDGE
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Roebling produces every major type of wire and wire product . . . house wire to telephone cable . . . bridge cable to wire rope . . . fine filter cloth to heavy grading screen . . . strip steel and flat wire to round and shaped wire . . . all Roebling products. *All* the result of over 100 years of wire specialization.
John A. Roebling's Sons Company, Trenton 2, N.J.

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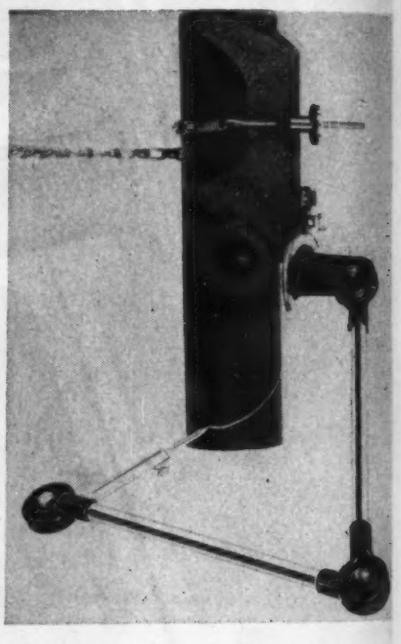
WIRE ROPE AND STRAND • FITTINGS • SLINGS • SUSPENSION BRIDGES AND CABLES
COLD ROLLED STRIP • HIGH AND LOW CARBON, ACID AND BASIC OPEN HEARTH STEELS
AIRCORD, SWAGED TERMINALS AND ASSEMBLIES • AERIAL WIRE ROPE SYSTEMS • ROUND AND SHAPED WIRE • ELECTRICAL WIRES AND CABLES • WIRE CLOTH AND NETTING

to back of case is insulated, so that recorded temperature is not affected by temperature of case itself. Available with mercury actuation in temperature limits of minus 38 to plus 200 deg. F. or equivalent C.; vapor actuated instruments in 0 to plus 300 deg. F. or equivalent C. Instrument measures 20¼x13¾x6¾ inches, weighs 18 pounds. Chart-driving mechanism can be supplied with periods of revolution to accommodate all regular recorder charts. Taylor Instrument Cos., 31 Ames St., Rochester 1, N. Y.

Protractor

Pipe, structural shapes, and flat sheets are said to be quickly and accurately scribed for cutting on any angle to ½ degree with Trumark Protractor, again being manufactured. Made of precision-machined cast bronze alloy and steel tubing in two stock models and three sizes. Joints are large in diameter and contain fiber bear-



ings to hold tension and maintain alignment. Marking arm is rigid throughout its travel. For use on flat surfaces, channel iron, T or I structural shapes, the protractor is set up as on pipe, or held square to any edge or corner. Plumb bob indicator and spirit level show any degree of angle from horizontal plane. Tru-Line Corp., 759 Venice Blvd., Los Angeles 15.

Steel Wall Desks

Steel wall desks, for inspectors, timekeepers, checkers, and others, are again available. Desks may be attached to any wall space, building column, or end of shelving racks. Model No. 2131-17 is 24⅜x23½x13 inches. Attachment bracket is 12 inches high, and is made of ⅞x⅞-in. angle steel. Desks have 24⅜x14-in. working surface, large storage compartment, and three open compartments across back. Each is equipped with pencil tray on either side, and grooved lock with two keys. Finished in green baked enamel. Lyon Metal Products, Inc., Aurora, Ill.

ANYONE MAY OBTAIN A LICENSE TO USE UNIONMELT Welding

Licenses may be obtained from:

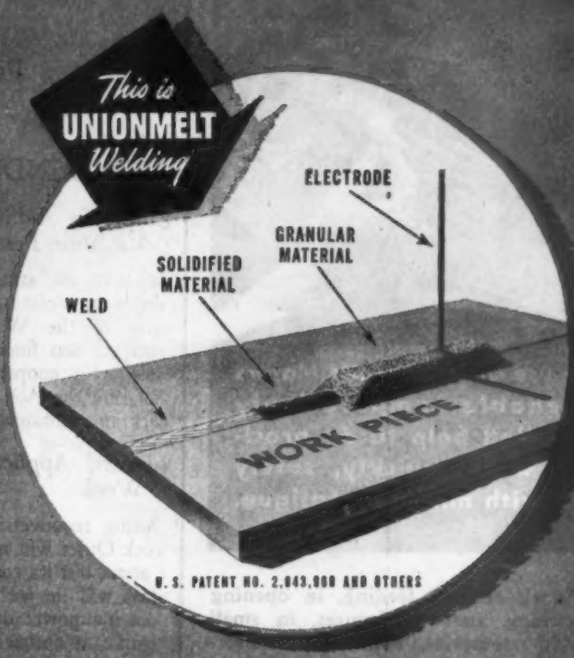
THE LINDE AIR PRODUCTS COMPANY

•

There are hundreds of licensees

AMONG WHOM ARE:

- Automobile Manufacturers
- Wheel Manufacturers
- Aircraft Manufacturers
- Shipbuilders and Ship Repairers
- Railroad Equipment Builders
- Chain Manufacturers
- Manufacturers of Pressure Vessels
- Manufacturers of Pipe and Tubes
- Structural Steel Fabricators
- Machinery Manufacturers
- Household Equipment Manufacturers

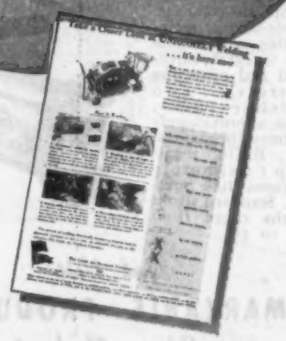


A process of welding electrically beneath a mineral melt

. . . and successful producers of other things as widely varied as airplane propellers, tanks, gun mounts, blowers, chemical plant equipment, conveyor screws, and sheet metal parts.

UNIONMELT welding is electric welding done as diagrammed above. It makes top quality welds at speeds that are greater than with any other similarly applicable process.

Anyone who wishes to use this patented invention may do so under our standard license agreement. License fees are low and based upon extent of use. Complete engineering assistance is available to licensees.



For additional information send for "Report No. 6 on the Use of Linde Methods in Mass Production" or ask a Linde representative to help you determine where you can use the UNIONMELT process advantageously.

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

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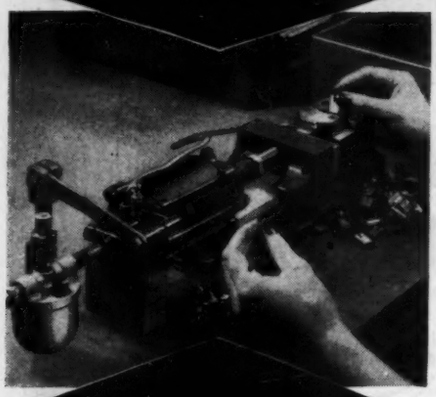
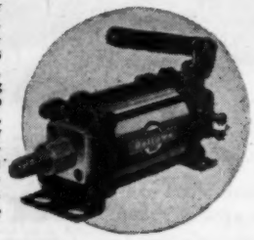
★ BUY UNITED STATES WAR BONDS AND STAMPS ★

AMONG SIGNIFICANT
Labor Developments



The use of Bellows Air Motors to enable comparatively unskilled help to do precision work, quickly, safely and with minimum fatigue.

In work or tool feeding, in opening and closing vises or fixtures, in small assembly operations, Bellows air motors supplant uniform, precise, controlled-air-power movement for operator "feel," making possible uniform production quantity and uniform production quality without strain or fatigue on the part of the operator



Bellows Air Motors are compact, double-acting, reciprocating power units with integral valve, speed and operating controls. Two models — BM5, thrust approximately 5 times line pressure; BM10, thrust approximately 10 times line pressure. Standard stroke lengths range from 1½" to 18".

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REMARKABLE PRODUCTION
Story Today!

Write for our new free Photo Facts File filled with large 8 x 10 application photos showing how ingenious production men are using Bellows equipment for faster, safer, better production. Production and cost data included. No obligation on your part, of course.

The **Bellows** Co.
861 E. TALLMADGE AVENUE
AKRON 10, OHIO

Significant Labor Developments

BENJAMIN WERNE, Lecturer in Government Regulations, New York University, Member of the New York Bar

Period Surveyed: June 10 to July 1

TREND INDICATORS

Employee Aiding Wage-Hour Violation Penalized

BECAUSE HE AIDED and abetted his employer in violating the child labor provisions of the Wage-Hour Law, a plant manager was fined. Penalizing plant officials who cooperate with employers in violating the Act supplies the government with an additional enforcement weapon.

Limited Application of 48-Hour Week

During reconversion, the 48-Hour Workweek Order will remain in effect in Group 1 areas, but its continuation in other labor areas will lie within the discretion of the area manpower directors. Employers with significant cutbacks may receive individual exemptions from the Order upon application to the area manpower director. Temporary exemptions may also be granted if necessary.

Held Under Walsh-Healey Act

A change in price of goods, bringing the employer's contract below $10,000, did not remove it from the scope of the Walsh-Healey Act. The original contract called for goods valued in excess of $10,000 but the price was later reduced to less than $10,000. The Secretary of Labor stated that the later contract merely changed price but left all other terms and conditions of the original contract intact. (Joseph W. Ozmer Lumber Company, Sec. of Labor)

Split-Day Plan Sustained

Change from a weekly plan of payment to a split-day plan, under which employees were compensated for a certain number of hours each day at regular rates and for overtime hours at time and one-half the regular rate, was held valid. The employees received the same total weekly wages under the split-day plan as they had received before the enactment of the Wage-Hour Law. The court pointed out this case and that of Helmerich vs. Payne, in which such a plan was held invalid, were different in that the contract regular rate here was not fictitious but that actually received by employees, while in the case of Helmerich the contract rate was lower than that actually paid, overtime was based on the fictitious rate, and no overtime was paid for true overtime hours. (Robertson vs. Alaska Juneau Gold Mining Company, USDC N. Calif.)

Held Time Worked

Time spent in traveling by employees of a floor construction and repair company from one job to another, and from their shop to jobs and back again. Payment of regular rates was directed for travel time from the jobs back to the shop in town and of time and one-half for overtime hours spent in such traveling. (Miller Brothers Floor Company, Wage Adjustment Board)

Deduction From Retroactive Pay

Employers should deduct income tax from retroactive payments for overtime or wages under the Wage-Hour Law whether or not the person to whom these payments are made is still an employee. Liquidated damages paid under the Act are, however, tax exempt. (Bureau of Internal Revenue)

Held Under the Act

Building service and maintenance employees in building occupied primarily by the administrative and executive staff of an interstate producer, since their work is "necessary" to the production of goods for commerce. The court explained that to draw a distinction between building service employees in the building where the goods are physically manufactured, and the employees in building where production of goods is administered and controlled, for purpose of determining coverage of the Act, is without economic or statutory significance. (Borden Company vs. Borella et al., U. S. Sup Ct.)

Employees in a plant cafeteria serving food solely to plant workers during lunch and rest periods, since they are "necessary" for the production of goods for commerce. (Basik vs. General Motors Corporation, Mich. Sup. Ct.)

Held Not Under the Act

Building service and maintenance workers of building which houses a variety of enterprises, since the management of an office building is an independent enterprise and too remote from the physical production of goods to claim that the work of these employees is "necessary" to the production of goods for interstate com-

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FAST-ACTING
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Cut Operating Time of Your Scrubbing Machine

All *Finnell* Floor-Cleaning Powders are specially compounded to work in scrubbing machines. The chemical action of these powders is compatible with the speed of machine-scrubbing! They act instantaneously on dirt, oil, grease, et cetera, so that your scrubber can more quickly remove the accumulation from the floor. This cuts operating time of your machine and saves labor.

The six *Finnell* Powders illustrated serve specific needs. *Setol:* An oil emulsifier developed expressly for quickly and safely removing grimy oil and grease from factory and mill floors. *Asesco:* Also an oil emulsifier, but recommended under conditions not requiring the potency of *Setol.* Both *Setol* and *Asesco* are all-purpose cleansers, effectively used for cleaning painted walls, woodwork, and ceilings, as well as floors. *Finola:* A scouring powder for heavy duty scrubbing of smooth, hard surface floors—such as terrazzo, cement, tile, and marble floors—and of some wood floors. Greaseless . . . leaves no dirt-holding film. *Century Scouring Powder:* A mild abrasive cleanser. *Solar Soap Powder:* Vegetable oil base . . . assures thorough, rapid cleansing. Recommended wherever a good *soap* powder is required. *Finnell Rubber Cleaner:* Endorsed by Rubber Flooring Manufacturers Association.

Finnell Powders are compounded in *Finnell's own mill,* and are put up in containers ranging from 5-lb. bags to 300-lb. barrels. For literature or consultation, phone or write nearest *Finnell* branch or Finnell System, Inc., 2508 East St., Elkhart, Ind. Canadian Office: Ottawa, Ont.

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ALL STEAMED UP

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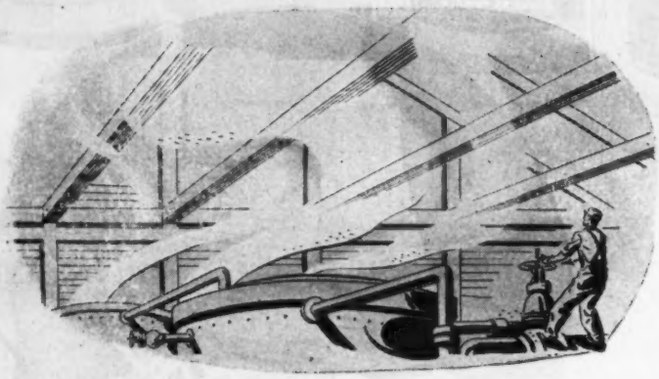

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merce. (10 East 40th Street Building, Inc. vs. Callus et al., U. S. Sup. Ct.)

WAR LABOR BOARD

* *WLB Rejects Wage-Hour Case*

A RWLB refused to take jurisdiction over a dispute involving a union's complaint that the regular rate of pay set by the Wage-Hour Division several years before was improper. The board declared that the matter was within the domain of the Wage-Hour Division. Dissenting members argued that the board has the responsibility of settling all labor disputes which come before it, and that the union's complaint was a *bona fide* dispute. (Kraft Cheese Company, RWLB-X)

* *Injunction Denied*

Court proceedings on the validity of a union's certification does not constitute reason for enjoining the WLB from holding hearings on a dispute between the company and the union in question. Because WLB orders are merely advisory and unenforcible by the courts, the court reasoned that injunctions may not be obtained against proceedings culminating in such orders. (May Department Stores Company, doing business as Famous-Barr Company, vs. Brown, USDC W. Mo.)

* *Profit-Sharing Bonus Extended*

Reversing a RWLB, the national board approved the extension of production workers' profit-sharing bonus to the firm's salesmen. The company pointed out that the salesmen's opportunity to receive commissions had been cut, since 89 percent of the company's production went to the government; that the reduction in the number of salesmen employed had increased their duties; and that similar companies in the area included salesmen in their bonus plans. (A. Wimpfheimer & Brother, Inc., WLB)

* *Increase Awarded Despite Increased Incentive*

Increased incentive earnings do not preclude an award of a wage increase due employees under the Little Steel formula. The RWLB involved was directed to reconsider the increase, which it had originally denied on the ground that an increase in addition to the increased incentive pay would have an unstabilizing effect. (Forged Steel Products Company, WLB)

* *Overtime to Include Incentive Bonus*

The regular rate of pay upon which overtime compensation is calculated must include incentive bonuses in addition to the basic hourly rate. Thus, any contract establishing a "regular rate" exclusive of incentive earnings is invalid under the Wage-Hour Law. The regular rate for overtime purposes must be based on the total amount of earnings per week, exclusive of

* In this and the following classification items marked with an asterisk also are considered to be trend indicators.

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LABOR DEVELOPMENTS (continued)

overtime. (Walling vs. Harnischfeger Corporation, U. S. Sup. Co.; Walling vs. Youngman-Reynolds Hardwood Company, U. S. Sup. Ct.)

* *Transference From Hourly to Incentive Rates*

A company's right to transfer employees from hourly to incentive rates, pursuant to a special contract provision, was upheld by WLB. The transferred employees, however, were entitled to their former hourly rate under the new incentive system, irrespective of their earnings after the transfer. (Erwin Cotton Mills Company, WLB)

* *Intraplant Adjustment Made*

Although it denied a union's request for the abolition of split shifts for kitchen workers in a city's major hotels, WLB, in effort to correct an intraplant inequity, awarded all the kitchen help a 30-cent daily split-shift differential which had heretofore been paid only to cooks. The board explained that it could not eliminate the split shift at present because it would require the hotels to hire a large number of additional employees and would not be conducive to the maximum utilization of labor. (Washington, D. C. Hotels, WLB)

* *War Labor Disputes Act Applies to Retailing*

On the ground that "production" includes distribution of goods, a circuit court of appeals held that the federal government has the right to seize Montgomery Ward Company's properties. The court explained that "production" in the War Labor Disputes Act is controlled by the definition of the term in the Wage-Hour Law which includes handling, transporting, and in any other manner working on goods for commerce. The court also pointed out that in applying for priorities the company recognized the applicability of the War Labor Disputes Act by declaring that the merchandise was to be used in vital war areas. (U. S. vs. Montgomery Ward & Company, Inc., CCA-7)

* *"Rare and Unusual" Case*

On a certification by the Army, WPB, and WMC that it was a "rare and unusual" case, the Wage Adjustment Board granted electricians in an important Army project an increase of 12½ cents an hour despite the fact that they had been previously denied a Little Steel increase of 8 cents an hour. The contractors on the job were unable to obtain the requisite labor because the rates set for the job were below the prevailing hourly rates in the area for the same type of workers. (Watson-Flagg Engineering Company, Wage Adjustment Board)

* *Temporary Increase Granted*

Practically doubling the company's request for a 10-cent increase to compensate employees for additional work imposed upon them by a fire in the plant, a RWLB granted a temporary 19-cent wage increase

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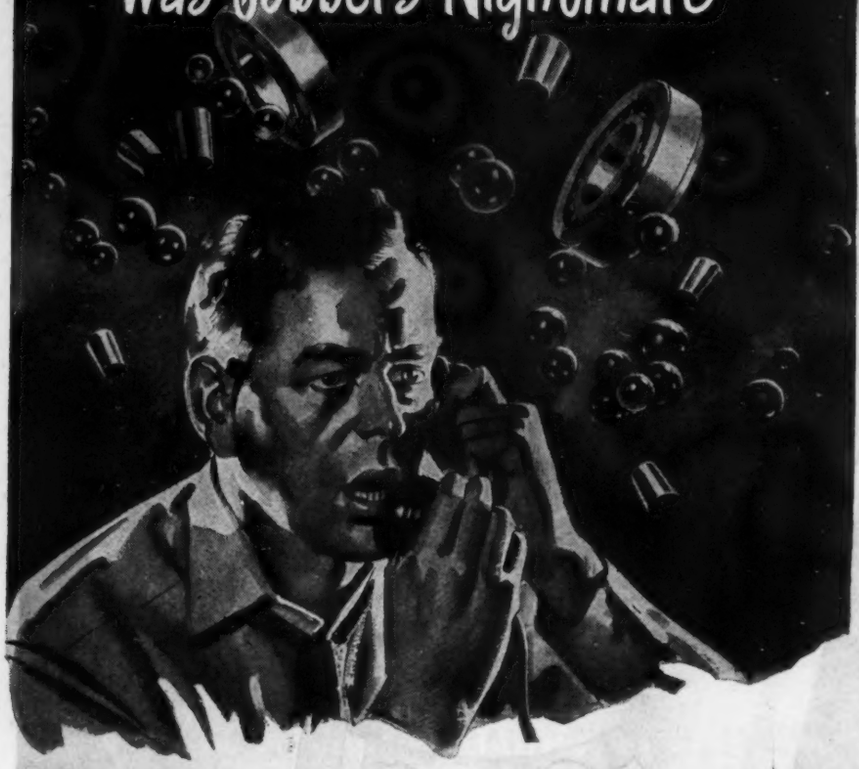

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The inventory of any supplier in the nation is within a matter of hours of your business when you specify this fastest delivery service.

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250	$1.04	$1.25	$1.57	$2.63
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for the period necessary to rebuild the plant. (Central Jersey Farmers Cooperative Association, Inc., RWLB-III)

* *Shift Premium Depends on Circumstances*

The award and denial of shift premiums for continuous, rotating, second, and third shifts in two cases were based upon the circumstances peculiar to each case. In one case, the award of the shift premium was held justifiable on the grounds that such was the area practice and that the onerousness of night work should be reflected in compensation (principle laid down in Basic Steel case). In the second case, the denial was based on the fact that the existing rates took into consideration compensation for night work, and that such payment was not industry or area practice. (Ideal Cement Company, RWLB-IX; Continental Oil Company, RWLB-VIII)

* *Prorated Vacation Policy*

Basing its policy on a survey of the policies of other regional boards, a RWLB adopted a schedule of prorated vacation benefits to be applied in all voluntary and dispute cases. The regional board declared that such proration was not a liberalization of vacation policy but merely an application of the standard 1 week for 1 year and 2 weeks for 5 years. The survey disclosed the fact that most of the regional boards approved prorated vacations in voluntary cases, although no board had the practice of granting it in dispute cases (RWLB-XII)

* *Sick Leave Awarded*

Despite the existence of a dispute, a RWLB awarded employees in an especially hazardous job a sick leave plan whereby pay is given for time lost by employees as a result of injuries sustained on the job, if they are not covered by state compensation. (Employers' Negotiating Committee, RWLB-VI)

* *Negotiating Time to Be Compensated*

Where the company had previously paid a group of seven union negotiators for time spent on contract negotiations during working hours, WLB ordered it to continue the practice and compensate union representatives, not to exceed seven, for time spent in present contract negotiations if the company holds the bargaining meetings during working hours. If, however, these sessions are to take place outside of working hours, payment by the company is not mandatory. (American Propeller Corporation, WLB)

* *Severance Pay Not to Be Negotiated*

On a finding that the severance pay practice was not prevalent in the industry or area, a regional war labor board negatived the panel's recommendation that a severance pay clause be negotiated by the parties despite the similarity between the copper refining company involved and basic steel. The dissenting members pointed out that wartime technological developments have

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made many older plants obsolete and that technological unemployment after the war is impending. (Phelps-Dodge Refining Corporation, RWLB-VIII)

* *Use of Union Labels*

Employers may not use union labels except if the union consents. Deeming the union label the property of the union, WLB granted the union's request to delete from its new contract a clause permitting the employer to exercise his discretion in using the union label. (General Cable Corporation, WLB)

NATIONAL LABOR RELATIONS BOARD

* *Union's Immunity From Anti-Trust Sustained*

The Anti-Trust Act is applicable to unions only if the latter engage in activities in conjunction with employers to restrain trade or competition. Thus, where a union agreed with a group of manufacturers and contractors to boycott all out-of-city and non-union goods, the court held the combination illegal. However, where a union, by refusing to admit to membership employees of a company, destroyed the company's business, the court held the union's conduct free from anti-trust prosecution. (Allen Bradley Company vs. Local Union No. 3, International Brotherhood of Electrical Workers, U. S. Sup. Ct.; Hunt vs. Crumboch, U. S. Sup. Ct.)

* *State Law Must Yield to NLRA*

Declaring that the National Labor Relations Act takes precedence over state regulations of unions and union officers, the Supreme Court deemed unconstitutional two sections of a state law requiring unions to register on penalty of being enjoined from functioning as a union and setting certain character and residence requirements for union agents. (Hill vs. Watson, State of Fla., ex rel., U. S. Sup. Ct.)

* *No Discrimination in Union Membership*

On the ground that closed shop is a monopoly of labor for a particular employer, and therefore is subject to the established principle that closed union membership is not compatible with closed shop privileges, a union was ordered to either accept Negroes into full membership, recognize the existing Negro auxiliary with full status, or waive its closed shop on behalf of Negroes. (Blakeny vs. California Shipbuilding Corporation, Calif. Sup. Ct.)

* *Anti-Closed Shop Provision Sustained*

A recently adopted amendment to a state constitution, wherein provision was made that no individual be deprived of work because of his membership or non-membership in a union, was held constitutional. The amendment was deemed a valid exercise of the state's policy power and provides nonunion workers a right heretofore

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Cleaning costs can be reduced as much as 50% with this Tennant Model K. Requires only *one* man to operate and plant departments remain in full working operation while floors are being cleaned. There's no need to waste time waiting for floors to dry when you use the Model K. It *leaves* floors ready for immediate *use.*

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The way to finer floors
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not enjoyed. (AFL vs. Watson, USDC S. Fla.)

** Majority Status*

In determining a union's majority, it is not necessary to count employees in the armed services as members of the bargaining unit inasmuch as the union's position among new employees should not be impaired by those, in the armed services, who are not immediately concerned with the choice of bargaining agent. Re-examination of the majority union's status, however, will be made when it can be shown that a sufficient number of veteran-employees have returned. (Supersweet Feed Company, Inc., NLRB)

** Boycott During Labor Dispute Legal*

Despite the fact that the union's action was tantamount to a boycott, a union's refusal, under its closed-shop contract, to deliver the employers' goods to a non-union contractor was held legal. The court deemed such action not illegal, since it was instituted during a labor dispute by a union who had a substantial interest in the labor relations of the nonunion employer, and since the union members merely operated with their employers in a manner contemplated by closed shop contracts. (Dominic Maurer, Inc. vs. Berks Products Corporation, et al., Pa. Ct. Com. Pls.)

** Picketing Held Illegal*

Picketing, conducted in such a manner as to prevent the entry of workers and thus cause the plant's shutdown, was held illegal. The court declared that the picketing was not conducted for publicity reasons but rather to "forcibly exclude" the employees. It therefore denied reinstatement to the striking employees. (NRLB vs. Indiana Desk Company, CCA-6)

** Posting Contract Required*

Investigation of a contract subsequent to the 3-month period after its execution is not barred where insufficient notice of the contract has been given. Generally, a contract is immune from such investigation if no complaint is lodged within the 3-month period and proper notice of the contract is posted. The required posting of the contract for 3 months cannot be substituted, however, by wide distribution of the contract to the employees by hand or mail unless actual notice is given to each and every employee. In the case involved, question as to the validity of the contracts was held appropriate since the contracts were not posted for the full 3 months and were not made available to all the employees. (Ken-Rad Tube & Lamp Corporation, NLRB)

** Employer's Committee Barred From Ballot*

An employers' committee of four employees with whom the management has made a contract does not preclude a determination of bargaining agent. The NLRB deemed such committee not a "labor organization" and excluded it from the ballot. (Reo Motors, Inc., NLRB)

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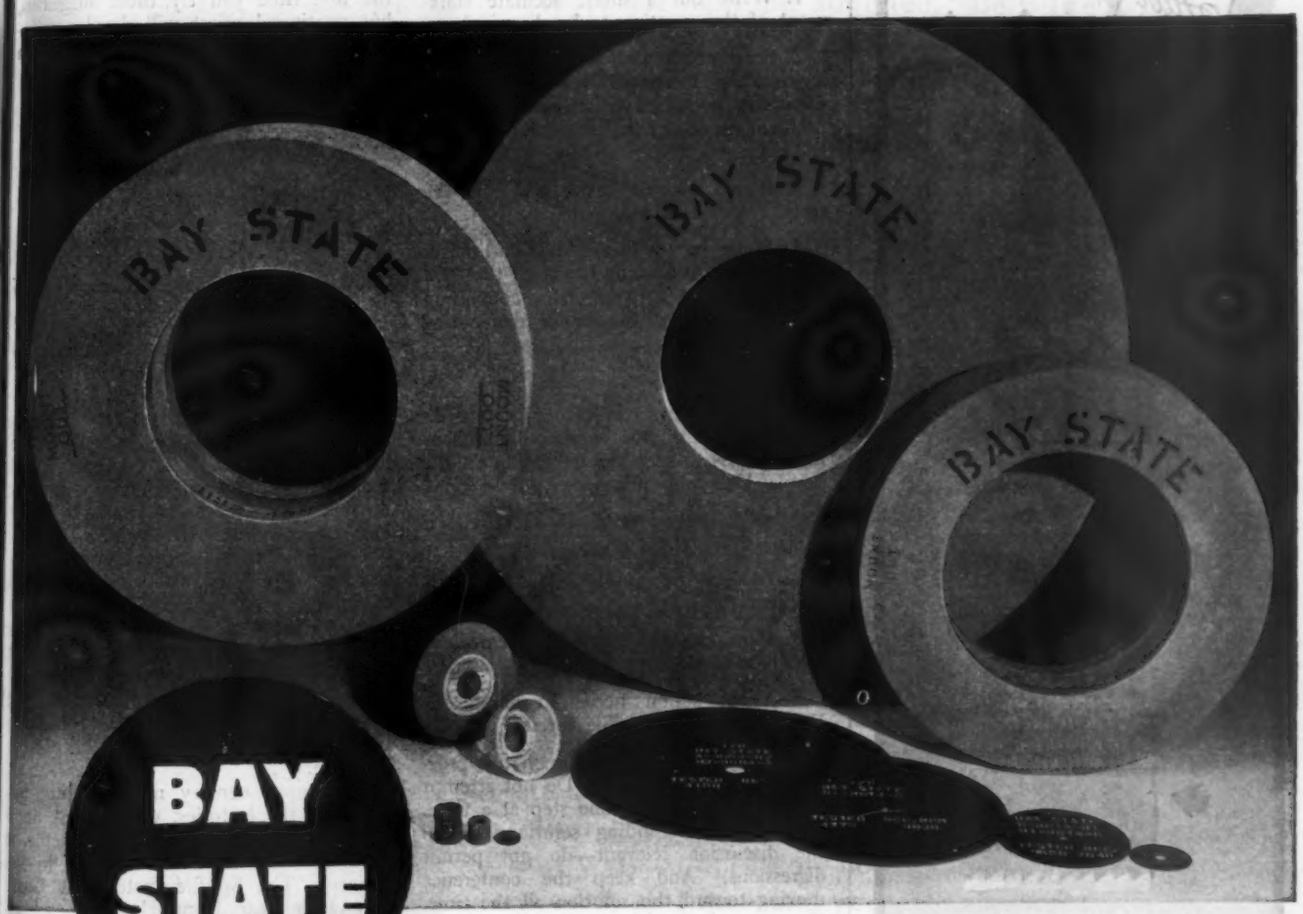

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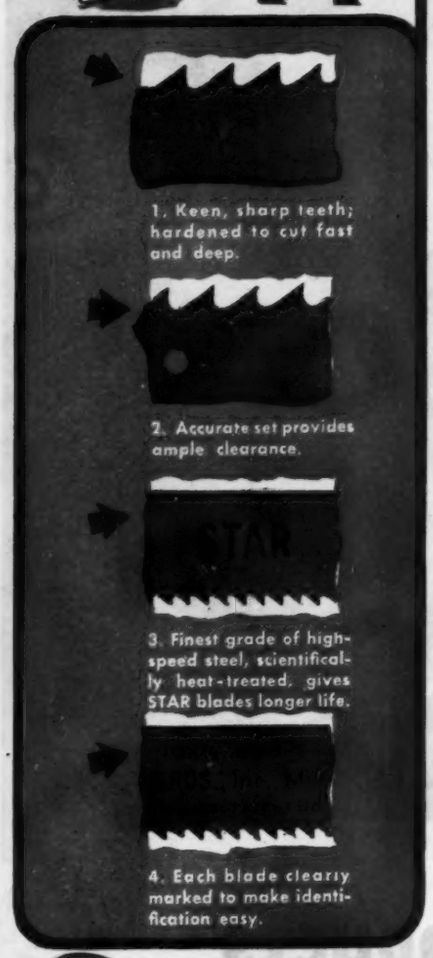

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TED W. HATLEN, Research Analyst, Industrial Relations Department, North American Aviation, Inc., Inglewood, Calif.

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Plan Ahead

One of the chief reasons for failure is the lack of planning. The leader who does not plan his conference is inviting disaster. Do these things in advance:

1. Write out a short, accurate statement of the question to be discussed.

2. Send out a written invitation to all legitimately interested parties. Include with the invitation a statement of the problem in order to stimulate advance thinking.

3. If any research is necessary, get the facts before the conference.

4. Make out a chairman's outline of the problem, indicating the steps that will be followed in arriving at a conclusion and all necessary questions demanding consideration.

Stay on the Beam

More conferences fail from lack of direction than any other reason. The chairman's job is to keep the discussion on the beam. Use this outline:

1. What is the problem? How does it affect us?

2. Analyze the problem. How does the problem show up?

3. How can the causes be remedied? What solutions are possible?

4. What action needs to be taken? Who will be responsible for it?

Direct the discussion through this process in an orderly manner. Do not attempt to discuss more than one step at a time. Analyze before finding solutions. Keep the discussion relevant—do not permit digressions. And keep the conference moving toward the solution all the time. Once a solution has been reached, fix responsibility and provide for follow-up.

Try These Procedures

1. Provide a physical situation in which people can see one another. Provide place cards and ash trays. Make it informal. See that a blackboard is available.

2. Start the meeting by briefly stating its purpose and the time limit.

3. Get the members of the group started by asking a question, or calling on a prepared member to give his opinion.

4. Keep the participants on the subject. Placing the question on the blackboard helps. Ask questions that lead directly to the subject.

5. Encourage maximum participation. Draw out the silent, restrain the overtalkative, assist participants in expressing themselves.

6. Keep the discussion moving. Ask for specific examples, summarize occasionally so everyone will know how the discussion is progressing, record progress on the blackboard.

7. Close the meeting properly. Watch the time limit, summarize progress made, fix responsibility for decisions made, indicate points for future study or discussion.

You will not be able to achieve success the first time you try these suggestions, but continued effort will develop an extremely valuable skill which will pay a lifetime of dividends.

•

Feeding Factory Workers in England

OSCAR C. GORENFLO, in a report to the Tea Bureau, New York

The British are still a cheerful, healthy people, despite many shortages in food, housing, clothing, and the daily essentials to good living that we are just beginning to feel here. . . . Some kids have never seen an orange or a banana, and all a great many of them know about candy is what they have heard from their older brothers and sisters. . . .

Food shortages and the sustained necessity for all-out national effort combined to force a remarkably efficient system of food control. As 80 percent of Britain's foodstuffs are imported, the government almost from the start of the war was able to enforce a control over distribution that we with our more intricate and commercialized system of marketing have never achieved. . . .

The supplementary mass feeding programs in the factories, worked out under government supervision is more efficient in most cases than those found in this country. The Spitfire factory, at Castle Bromwich near Birmingham, is an example of fast mass feeding. There 3000 workers a day are served in a little over 12 minutes, with the whole noon meal, from the time the workers enter the central dining hall until they return to their jobs, taking no more than half an hour.

This is accomplished by pre-plating 1200 dishes around 10.30 in the morning. These are put in warming ovens and. when the workers line up, cafeteria style, in front of the counters, the only thing left to do is to put gravy over the meat and vegetables. As soon as this original batch is drawn on, the remaining 1800 plates are

Any compressor drive is more efficient with automatic tension control.

Regardless of type of belt, any short-center drive should have a means of controlling tension automatically. With proper tension maintained at all times by means of pivoted motor base, more air will be supplied. Belt life will be lengthened . . . less strain on bearings . . . lower maintenance cost. *But,* automatic tension control is not the whole answer. Consider this:

And any compressor is more efficient with a VIM TRED BELT !

Leather belts are admittedly the toughest for severe compressor service. VIM Leather, made in Houghton's tannery by our exclusive mineral tannage process, is given a further treatment in the form of *treading,* which "gears" the belt to the pulley, restricts slipping, provides greater pulling power. Put a VIM Tred Leather belt on your compressor, hold it under proper tension at all times, and you have the best in power transmission. E. F. HOUGHTON & CO., 303 W. Lehigh Ave., Philadelphia 33, Pennsylvania.

Houghton's

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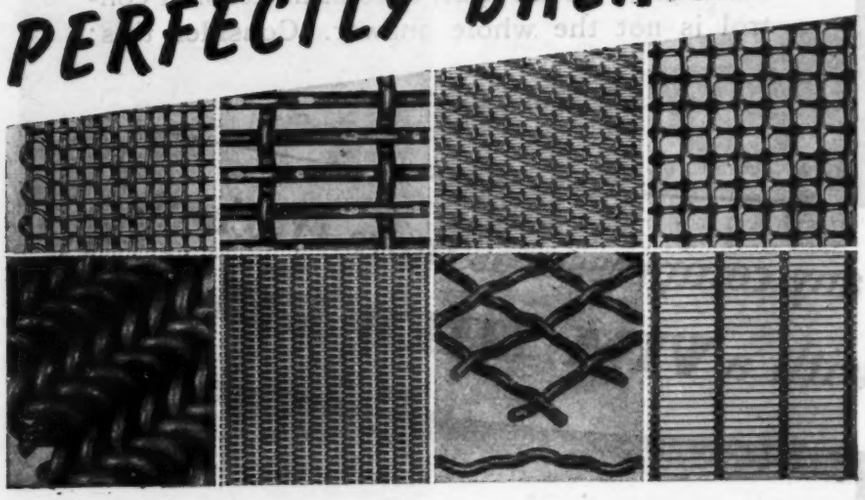
WIRE CLOTH COST AND SEPARATING SPEED

PERFECTLY BALANCED



To increase separating speed and lengthen your screen life, select a *higher quality alloy.*

Such alloys are woven by "Buffalo Wire." They permit you to go to a mesh of lighter gauge, and thereby achieve the perfect balance of productivity and screen life. The relatively higher cost of a durable alloy is more than offset by greater separating speed and less frequent wire cloth replacements.

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made up and put into the warming oven.

The food is simple, although adequate. The meal usually consists of a small slice of meat, two or three vegetables, and custard or similar dessert. It costs the worker about 8½d, or approximately 25 cents in American money.

The feeding program is self-supporting, largely as a result of more than 1000 gallons of tea dispensed daily at meals and during the morning and afternoon tea "breaks." At the equivalent of 3 cents a cup, operating cost and overhead are covered.

•

Financial Reports Keep Workers Informed

Company financial reports are becoming more and more important in the effort to keep workers up to date in their knowledge of what is happening to the business. But these reports can be so involved that they puzzle rather than enlighten, or so unattractive that they repel rather than draw interest.

That, in general, such annual reports are improving in character is proved by the results of a contest held by *Financial World.* Out of 2500 reports submitted in the contest, 372, or 30 percent, are rated as "modern," 457, or 37 percent are classified as "improved."

•

What Veterans Think About Management

What are veterans thinking—especially about management's and the unions' part in the war effort? One company, Wright's Automatic Machinery Company, Durham, N. C., was interested enough to find out. Through the company newspaper, *The Wamco Indicator,* a poll was taken of the 26 World War II veterans now working in that plant. To eliminate any "influencing" factors, the veterans filled out the questionnaire in private, and did not sign their names.

The questionnaire and replies follow:

Do you favor compulsory military training after the war for every able-bodied young man for a period of one year?

No, 2. Yes, 22. No opinion, 2.

Do you believe U. S. should participate more or less in foreign affairs than we did in the period between World War I and World War II?

More, 21. Less, 4. No opinion, 1.

How do you believe relations between the United States and Russia will be after the war as compared with our relations with England?

Better than with England, 2. About the same as with England, 9. Not as good as with England, 10. No opinion, 5.

How long, in your opinion, should we

Where can YOU use this amazing new VIBRATORY ram action?

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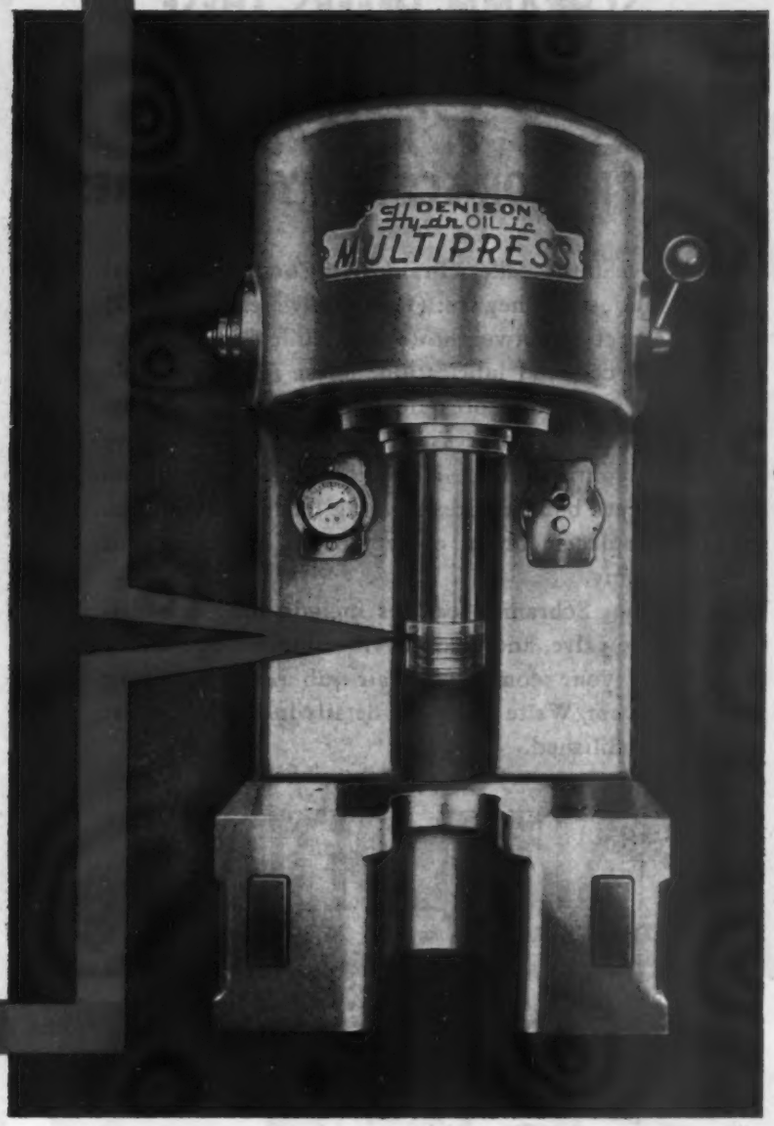
Ram action that permits short, rapidly-repeated uniform pressure strokes of regulative length, frequency, pressure and number per ram cycle



● So many startling advantages have been found in this new *exactly-controlled vibratory ram action* that, thus far, even we know only a few of its potential applications. Performance tests indicate that it may *revolutionize* scores of operations!

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keep an Army of Occupation in Germany?

Six months, 1. One year, 3. Two years, 3. Three years, 3. Always, 14. No opinion, 2.

When you were in service what was your opinion of union cooperation with the war effort?

Excellent, 7. Good, 11. Fair, 4. Poor, 3. No opinion, 1.

What is your opinion now of union cooperation with the war effort?

Excellent, 9. Good, 11. Fair, 4. Poor, 1. No opinion, 1.

When you were in service what was your opinion of management's cooperation with the war effort?

Excellent, 10. Good, 9. Fair, 5. Poor, 1. No opinion, 1.

What is your opinion now of management's cooperation with the war effort?

Excellent, 12. Good, 8. Fair, 4. Poor, 1. No opinion, 1.

Do you believe the vet is getting an even break from the government, employers, and public?

Yes, 20. No, 5. No opinion, 1.

•

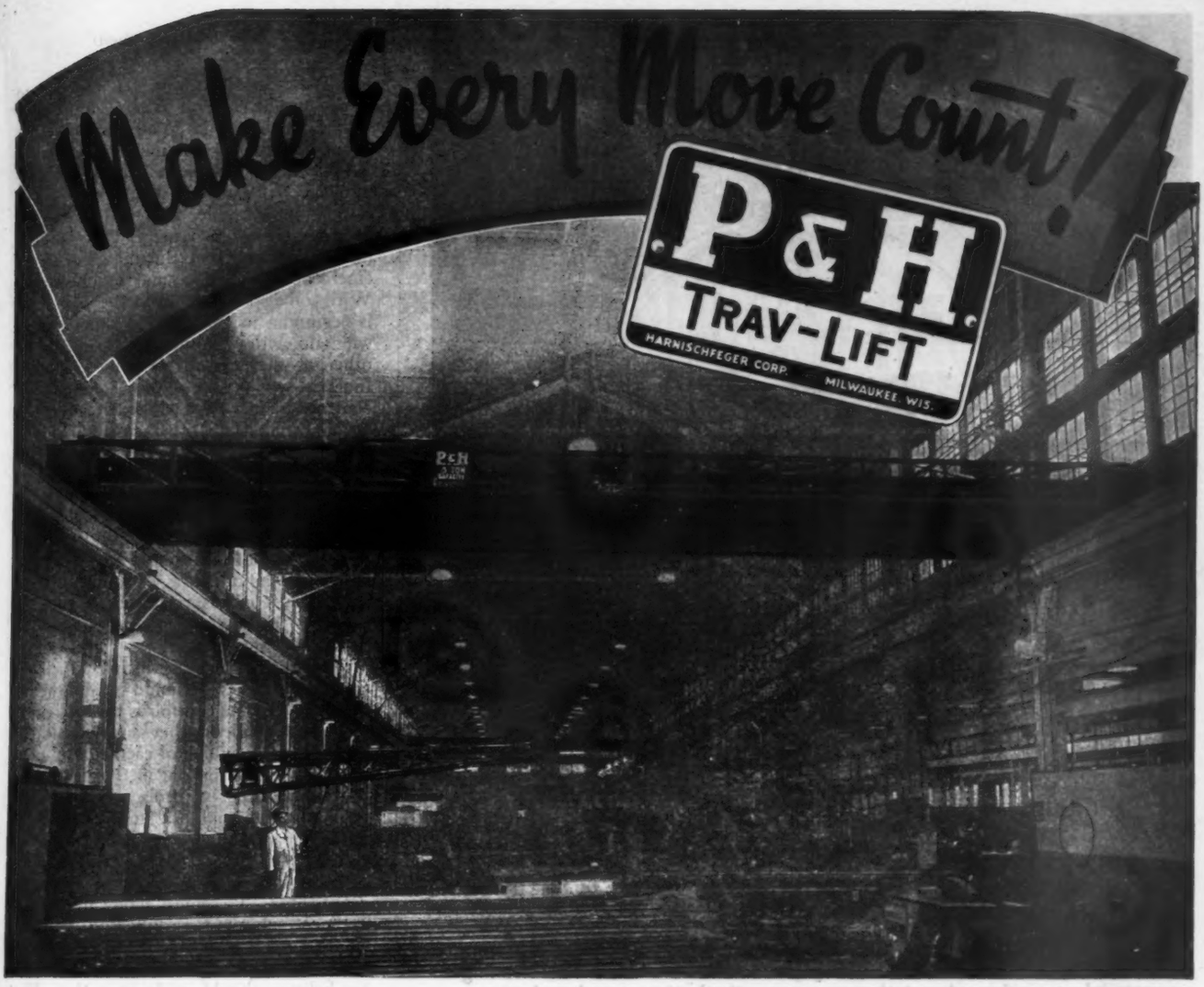
When and How Controls Should Be Removed

RAYMOND RUBICAM, Member of the Research Committee of the Committee for Economic Development, before the House Special Committee on Post-War Economic Policy and Planning

The primary purpose of the CED is to encourage and assist businessmen to make their maximum contribution to the achievement and maintenance of high production, high consumption, and high employment in the nation. These objectives must be attained within the framework of a vigorous and expanding economy in which the great volume of jobs will be provided by free enterprise.

To this end, the CED has helped organize more than 2800 local CED committees, with a working membership of more than 60,000 businessmen. . . But the efforts of individual business men and companies to expand and increase employment—important as they are—cannot succeed unless we have a favorable economic climate in which individual plans will have a chance to become realities. For this reason the CED established its national Research Committee. Its work is to study economic conditions and economic policies objectively and impartially, in order to discover what policies, whether of government, business, labor, or agriculture, will create a climate in which such growth can take place.

Following such studies, the Research Committee from time to time issues recommendations as to the policies which, in its considered judgment, should be pursued if we are to have a high level of jobs and production after the war. The statement



Every time you handle your product, you add to its finished cost. So make every move count! Beware the sluggishness that comes with human fatigue. See that work for skilled hands is delivered promptly . . . and promptly removed. Avoid unnecessary rehandling.

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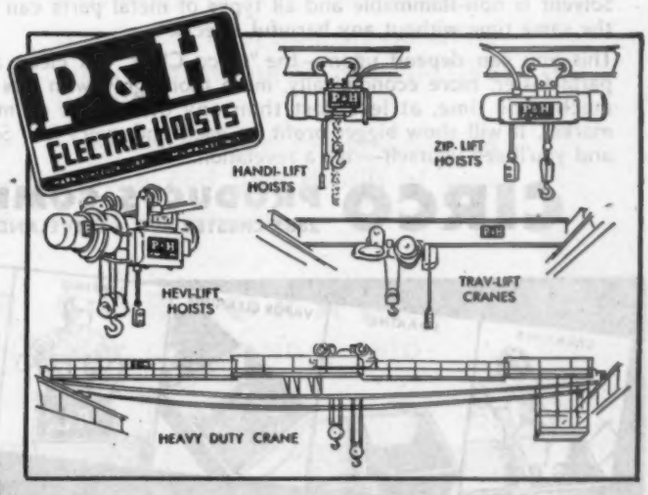

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This you can depend upon—the "Circo Chief" will clean and dry metal parts faster, more economically, more thoroughly with less effort, less of mechanic's time, at less cost than any other unit or method on the market. It will show bigger profit on each and every job. See it in action and you'll sell yourself—it's a revelation.

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recently issued, and which I am here to discuss, called "Post-War Employment and the Removal of Wartime Controls," is one such policy statement. . .

First the committee lays down the basic principle that controls should be removed as soon as possible after the emergency need for them has passed. This does not mean, however, that the duration of the emergency will be the same for all controls. With some specific controls the emergency is beginning to end now; in other cases it will end with victory over Japan; in still others it may extend for some time into the post-war period. With some specific controls gradual steps toward removal will be advisable—with others removal can be complete.

Clearly, no control should be removed at a time when its removal would jeopardize any phase of the war effort or threaten the successful transition to a healthy peacetime economy. But we should guard against indefinite continuance of any of these emergency controls just because they are there, or because they have worked well during the war.

The second general principle which the committee believes should guide the removal of wartime controls is this: Controls are interdependent, they supplement one another. The ending of each control must therefore, be considered in the light of its relation to other controls. For example, price control would be more difficult if rationing and wage controls were ended. As controls are so interdependent, their suspension or removal must be effectively coordinated. Piecemeal action by separate agencies subject to conflicting pressures would not produce orderly demobilization.

The third principle which the Committee believes should guide us is this: That until victory over Japan is won, controls should be removed by administrative action only, where the need for them no longer exists. It is universally conceded that if legislative authority to control is ended and later needed, its timely restoration would be difficult, if not impossible. . .

We set up controls in this war with a fourfold objective: (1) To insure a more effective use of our resources for victory; (2) to provide equitable distribution of the more vital civilian goods and services; (3) to prevent a disorderly rise in prices; and (4) to facilitate a safe return to a peacetime economy.

Each of these reasons is of vital importance to the nation; together they are all-important. But it is obvious that the first one, "to insure a more effective use of our resources for victory," is the most compelling one. As we move toward total victory there is bound to be a mounting demand for removal or crippling of controls which may still be needed in the transition to help us win the peace as well as the war. With victory over Germany won, we now face the first test of our determination to decide the continuance or removal of controls with full regard for all four requirements of our objective.

From now until the end of the Japanese war, we shall be confronted with a set of abnormal and unbalanced conditions marked by: (a) Shortages of many civilian

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Ohio Tramrail Systems carry larger loads to the destinations—without rehandling. The job gets done faster—more efficiently; less lost motion — less wasted time. Various types of "below-the-hook" devices available to suit the material moved.

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AN-C-52a Type 1 alternate	Compound, Exterior Surface Corrosion Preventive	*Tectyl 481*
52-C-18	Compound, Rust Preventive, Thin-Film (polar type)	
	GRADE I	*Tectyl 506*
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goods, particularly durable and semi-durable goods; (b) large accumulated purchasing power; (c) low output of many shortage goods; (d) surpluses of important raw materials, and of manpower in many places.

The seriousness of these conditions at V-J Day will depend on the length and character of the war and the speed and extent of reconversion at that time. . .

Controls Over Production

Depending upon the specific need, many different types of controls have been set up on the production front. For example, there have been prohibitions or limitations on the production of less essential civilian goods. There has been allocation or controlled distribution of essential materials and components. Inventories have been reported regularly and limited as to their size. Standardization and simplification orders have served to reduce the number of models manufactured.

In cutting back, each of these may require different handling, but in general the Committee believes that:

Prohibition or quota limitations on production should be among the first suspended. Action on this by the War Production Board has begun.

When production restrictions are suspended, orders requiring the use of substitute materials should also be ended to the fullest extent permitted by the availability of materials.

The suspension of the production controls should be paralleled by the suspension of construction controls, subject to available materials and manpower. Cases of industrial construction which will aid employment are particularly important. They should be facilitated at the earliest possible moment.

Materials and components should still be allocated for military purposes and ample strategic stockpiles held until the end of the Japanese war. The military should not have to compete with civilian industry for its supplies.

Allocation controls for civilian production should be ended selectively at any time a serious shortage of a particular material no longer exists, and supply and demand come close enough in balance to remove danger of inflationary price levels.

Inventory limitations should be suspended by administrative action as soon as the supply of the particular materials or product is sufficient to remove allocation controls. As long as there is any threat of inventory hoarding, however, it is desirable that some form of inventory reporting be required to permit authorities to spot this potent symptom of inflationary pressure. . . .

The pattern between V-E Day and V-J Day will present such difficult problems as these:

1. Materials may be available when production facilities and manpower are still tight; or both materials and facilities may be available while manpower is still short, or vice versa. Local or regional shortages of labor may exist concurrently with a national manpower surplus. These situations

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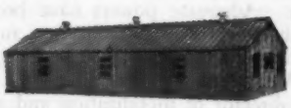

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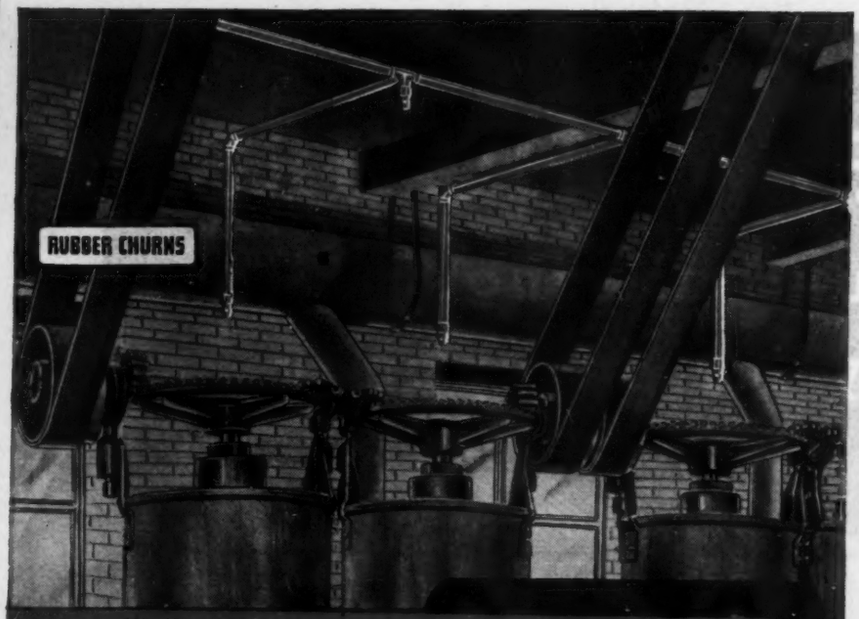

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present various problems. No simple rule can be given to solve them.

2. Materials, facilities, and manpower may be available in limited amounts which are far less than needed to fill the combined war and civilian demand. This would impose difficult problems of establishing limited production quotas for some industries and for units of an industry.

Policy in this period must prevent a competitive scramble for scarce materials, which might have dangerous effects. Such a scramble might interfere with military needs. Small business would suffer in comparison to large. The pressure on the price structure might prove irresistible.

Price Controls

If price controls were suddenly ended while supplies were still inadequate, prices might soar chaotically to inflated levels. If the wartime pattern of prices were rigidly maintained, existing maladjustments in costs and prices would retard post-war business expansion.

Prices hold a key position in the whole control problem. . . .

The objective should be a level of prices high enough to induce the required expansion of production and employment, and at the same time low enough to maintain the necessary consumption under normal conditions of demand and supply. . .

Ending All Controls

One type of extremist will tend toward the ending of controls too early for the sake of freedom of action all along the line. Another type of extremist will tend to cling to controls because he cannot foresee the full consequences of giving them up. The adoption of either extreme view could be disastrous. . .

The Committee recommends the following procedure for the ending of wartime controls:

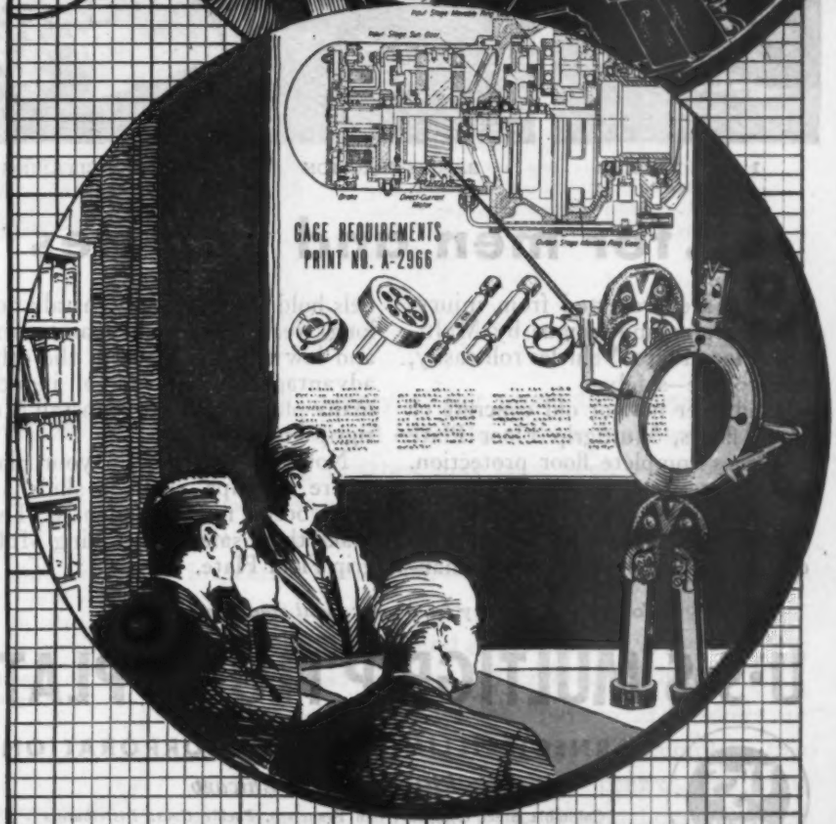
From the present until six months after final victory, controls should be removed by administrative action only, wherever the need for them no longer exists. During the fighting each such suspension must be justified by cutbacks or surpluses which make facilities, materials, and manpower adequately available over full military needs.

As controls are interdependent, their administrative suspension must be effectively coordinated. Piecemeal action by separate agencies subject to conflicting pressures would not produce an orderly demobilization. Adequate powers have been given to the director of mobolization and reconversion to control such suspensions.

Within six months after final victory, the director of mobilization and reconversion should review all controls and should, not later than six months after victory, remove all remaining controls not clearly necessary beyond that date. A period of six months after final victory will permit substantial reconversion, and will also coincide with the expiration of some of the President's emergency war powers.

Legislative authority should be con-

GAGE ENGINEERING SERVICE



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This patented tread pattern, shown actual size, provides many skid-foiling buttons to grip and hold each shoe, every step. The flat-topped risers of Multigrip Floor Plate assure safe starts, turns and stops—wet or dry.

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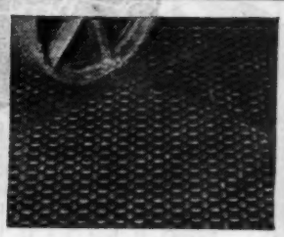
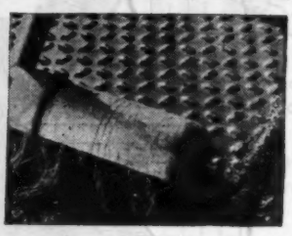


2. SURE TRACTION



3. QUICK CLEANING

...for men and vehicles

MEN are protected from injury, strains and fatigue by Multigrip Floor Plate. Vehicles roll easily, true to line—safely.

Laid over new or old concrete or wood floors, Multigrip Floor Plate furnishes complete floor protection. The safety pattern has no pockets to hold dirt and grease, is easily cleaned in any direction. Also drainage is quick and complete, no closed channels hold water. Speedy installation, long wear, minimum maintenance and low cost are some of the other advantages which have induced many plant engineers to install Multigrip Floor Plate.

Note the locations in your plant where mishaps, such as skids and falls, occur most frequently. Then make them safe by installing Multigrip Floor Plate.

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CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
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UNITED STATES STEEL

tinued or extended beyond that date only for such wartime controls as may be plainly needed to hold inflation in check during the remainder of the transition period. The legislative authority should not, however, be exercised except as determined by the director of mobilization and reconversion.

At the end of the transition period as determined by Congress, legislative authority for the last of the wartime controls should be ended. . .

National policy on the end of controls should be clearly stated at the earliest possible time. The American people should be informed that such policy aims at the complete ending of all wartime controls within a limited period of time.

•

Proposed Policy For Post-War Retooling

In an effort to promote the preparation for post-war business, the firm of Myers, Fuller & Addington, New York, has proposed to its clients and to the professional engineering societies that the following program be urged upon the government:

Whereas

the post-war period is imminent with its problems of maintaining full-scale employment of American workers and at the same time rehabilitating the industrial plant of our war-torn competitors; and

Whereas

only if the United States remains solvent by the maintenance of a very great volume of profitable business can it assume its share in acting as banker for the rehabilitation of the devastated countries.

We Propose

that the following policies be promptly adopted and rigorously carried out, to wit

1. That the system of priorities now applied to tools and equipment needed for the production of consumer goods be maintained and adapted to provide

2. **First** priority to industries in the United States for all new and modern tools and equipment to replace older and used equipment of the same nature;

3. **Second** priority to the rehabilitation of tools and equipment thus replaced for sale to the devastated countries;

4. **Third** priority to the production of new equipment for sale and delivery to those countries upon which we most rely for raw materials and trade in consumer goods.

Against foreign labor welfare standards much inferior to our own we must oppose a superiority in tools and equipment in order to compete for trade on an equal dollar basis. Only by winning a good share of foreign trade can we obtain the volume of business necessary to enable us to supply credit for world rehabilitation and to retain our national economy.

housecleaning recommended

Remove temperature-raising "dust" overcoats for top performance of breakers and switches

AVOID THIS . . .

Too much dust is accumulated on these switches and starters. Dust forms a heat-insulating "overcoat" which prevents normal heat radiation and raises operating temperature.

Westinghouse Recommends These Steps when Inspecting Safety Switches

1. Make sure disconnect ahead of switch is open.
2. Clean contacts, and check for alignment and proper pressure on hinge and break jaws. Apply light coat of sludge-free lubricant.
3. Remove and clean fuse contacts with fine sandpaper; check fuse ratings; tighten fuse contacts.
4. Clean switch base and insulating parts.
5. Make certain cable connections and lugs are tight.
6. Check switch for smooth operation and clearance of arc extinguisher, safety shields, etc. Lubricate operating mechanism.
7. Keep cabinets clean and free from rust—and keep covers closed.

In the urgency of war production, inspection and cleaning of vital controls, such as enclosed breakers and safety switches, may have been overlooked. Because these are vital links in your plant power distribution system, Westinghouse recommends periodic inspection and "housecleaning".

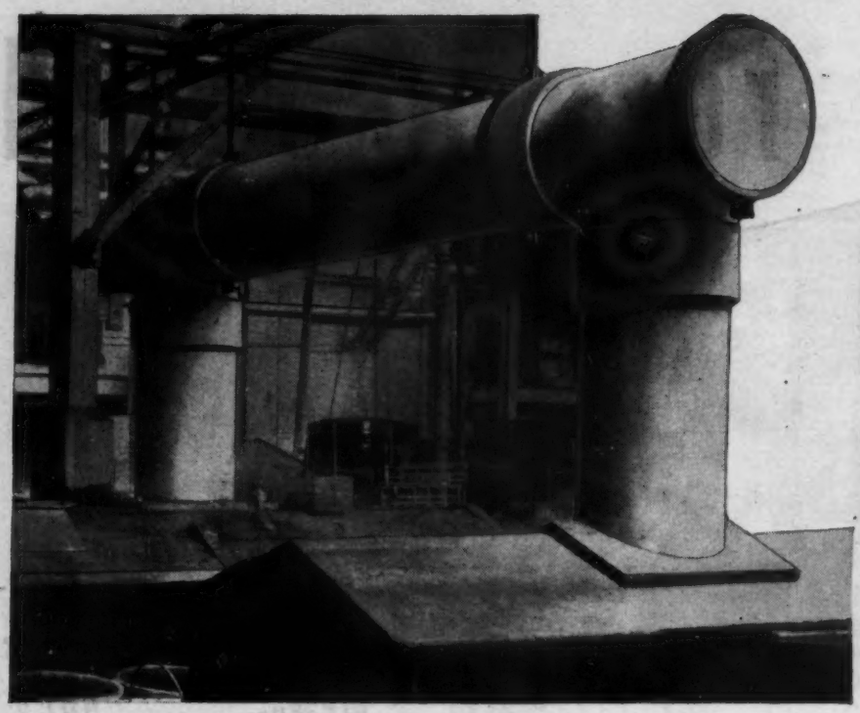
Benefits are manifold: reduced maintenance, higher operating efficiency and safety standards, protected investment, and not least... increased production.

Safety switches and Type AB-I circuit breakers are only two items of the Westinghouse complete line of standardized control. For *any* control, call your Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60605

Westinghouse PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

AB-I BREAKERS AND SAFETY SWITCHES

FIGHTS CORROSION!



Transite asbestos-cement ducts resist corrosive attack by many vapors, fumes, gases

WHERE corrosion problems must be met in venting systems, many users find the trouble-saving answer in Transite "S" Pipe. Made of asbestos and cement, it cannot rust . . . successfully resists many corrosive fumes, vapors, dusts, gases, etc., encountered in industrial operations.

Strong and durable, Transite "S" Pipe can be used indoors or out—for ducts, vents or stacks. It is highly weather-resistant—needs no painting.

Installation of these modern asbestos-cement ducts is simple. Light in weight and readily assembled, Transite "S" Pipe comes in a range of 19 sizes, in diameters from 2" up to 36". A complete line of fittings is available.

For complete information, write today for data sheets DS Series 336. Address Johns-Manville, 22 East 40th Street, New York 16, New York.

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Johns-Manville TRANSITE 'S' PIPE

BOOKS

TRAINING FOR SUPERVISION IN INDUSTRY

George H. Fern, Director, Michigan State Board of Control for Vocational Education; State Director, War Production Worker Training and Food Production War Training. McGraw-Hill Book Co., 330 West 42nd St., New York 18, 188 pages. Forms, index. $2.

One of the "Organization and Management Series." Concerned primarily with the responsibilities of a supervisor as an instructor. Book is intended to give direct help to the supervisor with the problems of his daily job, especially in the fields of human relations and training. The conference method of breaking down job problems and analyzing them through group discussion is presented as a sound and certain means of arriving at understandings and definitions, true facts, and proved solutions. Eleven chapters: The Supervisor and His Job; The Importance of Mental Health to Industry; Safety and Accident Prevention; Women in Industry; Starting a New Worker Right; Supervisors and Job Relations; How to Analyze Jobs; How to Lead a Conference; Training Conference Discussion Topics and Analyses; The Supervisor as an Instructor; and Training Opportunities Available Today.

PRACTICAL MANAGEMENT RESEARCH

Alexis R. Wiren, Assistant Superintendent, Group Department, The Equitable Life Assurance Society of the United States; and Carl Heyel, Lehn & Fink Products Corp. McGraw-Hill Book Co., 330 West 42nd St. New York 18, 222 pages. Forms, index. $2.50.

One of the "Industrial Organization and Management Series." Gives the theory, principles, and methods for research into management problems, with an "engineering" approach to the factors that make for effective operation and well-established control. Book describes effective methods for analyzing business problems and for conducting practical management and time studies. In two parts. Part I gives principles of practical management research; Part II shows case examples of the systematic solution of management problems.

HOW TO SPEED UP SETTLEMENT OF YOUR TERMINATED WAR CONTRACT

J. K. Lasser, CPA in New York, New Jersey, and California; Chairman, Institute of Federal Taxation, New York University. McGraw-Hill Book Co., 330 West 42nd St., New York 18. 186 pages. Index. $3.75.

Designed to tell small and large plants what they can do when their war orders are canceled or curtailed. Includes a guide to tell subcontractors how to proceed and how to get maximum protection.

ELECTROMAGNETIC ENGINEERING

Volume 1, Fundamentals. Ronold W. P. King, Associate Professor of Physics and Communication Engineering, Harvard University. McGraw-Hill Book Co., 330 West 42nd St., New York 18. 580 pages. Figures, index. $6.

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LABOR CONTRACT CLAUSES

In the Automotive and Aviation Parts Manufacturing Industry. Compiled and edited by Malcolm W. Welty. Automotive & Aviation Parts Manufacturers, Inc., 800 Michigan Bldg., Detroit 26. 488 pages. Index. $2.75.

A report rather than a manual of recommended standard practice. Clauses are taken verbatim from approximately 200 current labor contracts in the field, most of them concerning hourly rated factory employees. In 14 chapters, including Recognition and Scope of Bargaining Unit; Representation; Union Security—Union Status; Management Functions—Company Status; Grievances and Grievance Procedure; Seniority; Hours and Conditions of Work; Wages; Vacations or Vacation Bonuses; Leaves of Absence; Health, Safety, Accidents, Insurance; and others.

BOOKLETS

EMPLOYEE ORGANIZATION FOR FIRE SAFETY. National Fire Protection Association, 60 Batterymarch St., Boston. 40 pages. Drawings in color. 25c for one copy, less when ordered in quantities.

PROVISIONS IN COLLECTIVE BARGAINING CONTRACTS. Selected reading. Prepared by May E. Jamieson, Research Assistant. Industrial Relations Section, California Institute of Technology, Pasadena 4, Calif. 4 pages. No charge.

WAR PRODUCTION IN 1944. Report of the chairman of the War Production Board. U. S. Government Printing Office, Washington, D. C. 142 pages. Charts. Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C. 25c.

STRAIGHT TALK FOR DISABLED VETERANS. Edna Yost. Public Affairs Pamphlet No. 106. Public Affairs Committee Inc., 30 Rockefeller Plaza, New York 20. 31 pages. Cartoon drawings. 10c.

ARMY-NAVY CONTRACTORS GUIDE for prime and subcontractors. Suggestions to war contractors as to methods of, and advance planning for, settlement of terminated fixed price supply contracts with the Army and Navy. Issued jointly by the War and Navy Departments. 59 pages. Cartoon drawings, forms. Obtainable from Readjustment Distribution Center, 6th floor, 90 Church St., New York 7. No charge.

THE RETURNING VETERAN AND YOUR INSURANCE PROGRAM. Group Life and Pensions; Safety; Casualty Insurance; Group Accident and Health. Insurance Series No. 60. American Management Association, 330 West 42nd St., New York 18. 27 pages. 50c.

SHOULD MANAGEMENT BE UNIONIZED? H. W. Anderson, General Motors Corp. Personnel Series No. 90. American Management Association, 300 West 42nd St., New York 18. 18 pages. 50c.

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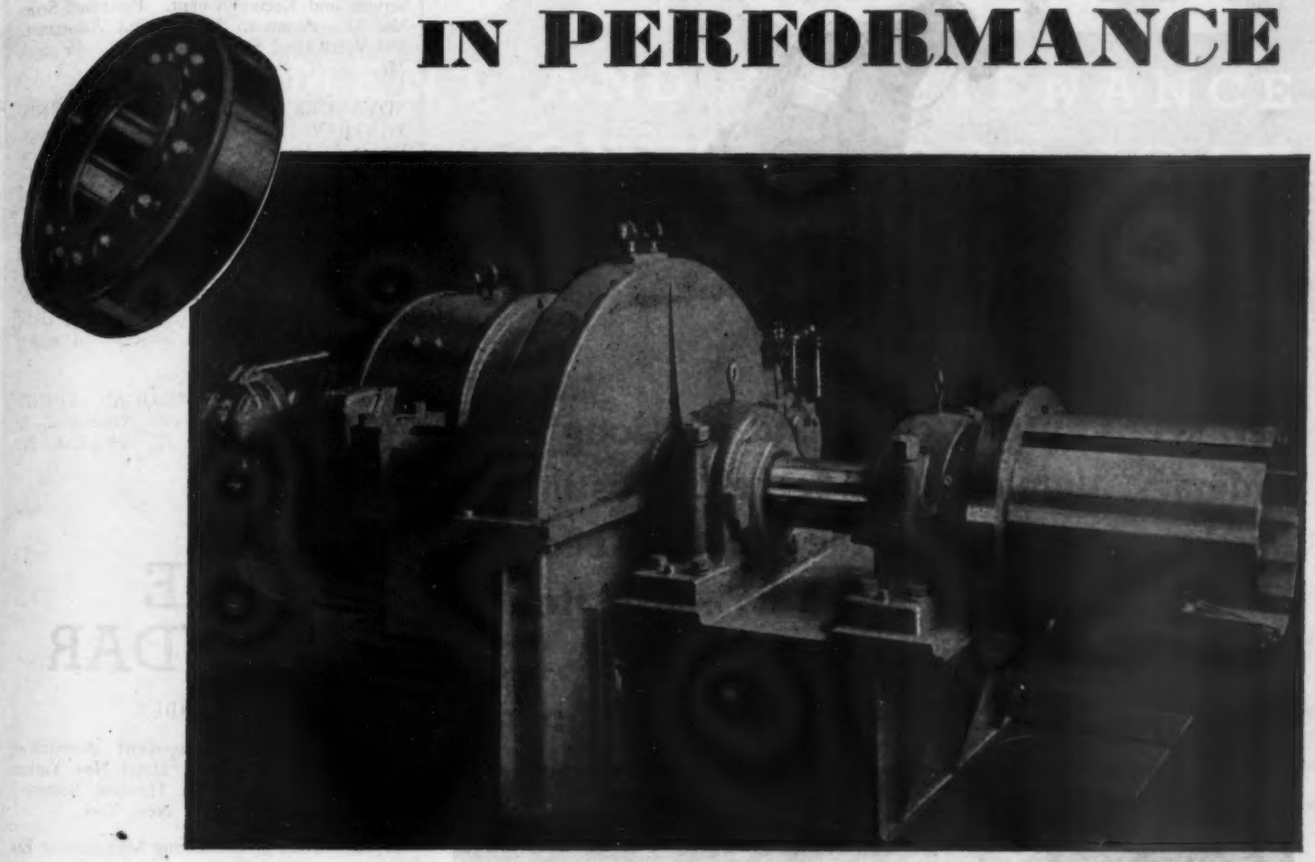

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BOOKS, PUBLICATIONS, and PATENTS of Batelle Memorial Institute, 1929-1944. Compiled by Thelma R. Reinberg, Librarian. Batelle Memorial Institute, Columbus, Ohio. 72 pages. Photographs, subject and author indexes. No charge.

PRICE LIST OF AMERICAN STANDARDS. American Standards Association, 70 East 45th St., New York 17. 24 pages. No charge.

ON THE CALENDAR

SEPTEMBER

18–19, American Management Association, Packaging Conference, Hotel New Yorker, New York. Henry J. Howlett, Secretary, 330 West 42nd St., New York.

21, Association of Consulting Management Engineers, Inc., Program Meeting, University Club, Chicago. Nathaniel W. Barnes, Executive Secretary, 347 Madison Ave., New York.

OCTOBER

9–10, American Management Association, General Management Meeting, Hotel Pennsylvania, New York. Henry J. Howlett, Secretary, 330 West 42nd St., New York.

30–31, American Management Association, Production Conference, Palmer House, Chicago. Henry J. Howlett, Secretary, 330 West 42nd St., New York.

Meetings Canceled

AUGUST

American Institute of Electrical Engineers, National Technical Meeting. H. H. Henline, Secretary, 33 West 39th St., New York.

SEPTEMBER

Association of Iron & Steel Engineers, Annual Technical Conference, Pittsburgh. Brent Wiley, Managing Director, Empire Building, Pittsburgh.

OCTOBER

American Society for Metals, National Metal Congress and Exposition, Cleveland. W. H. Eisenman, Secretary, 7301 Euclid Ave., Cleveland 3.